THE MARINE REVIEW

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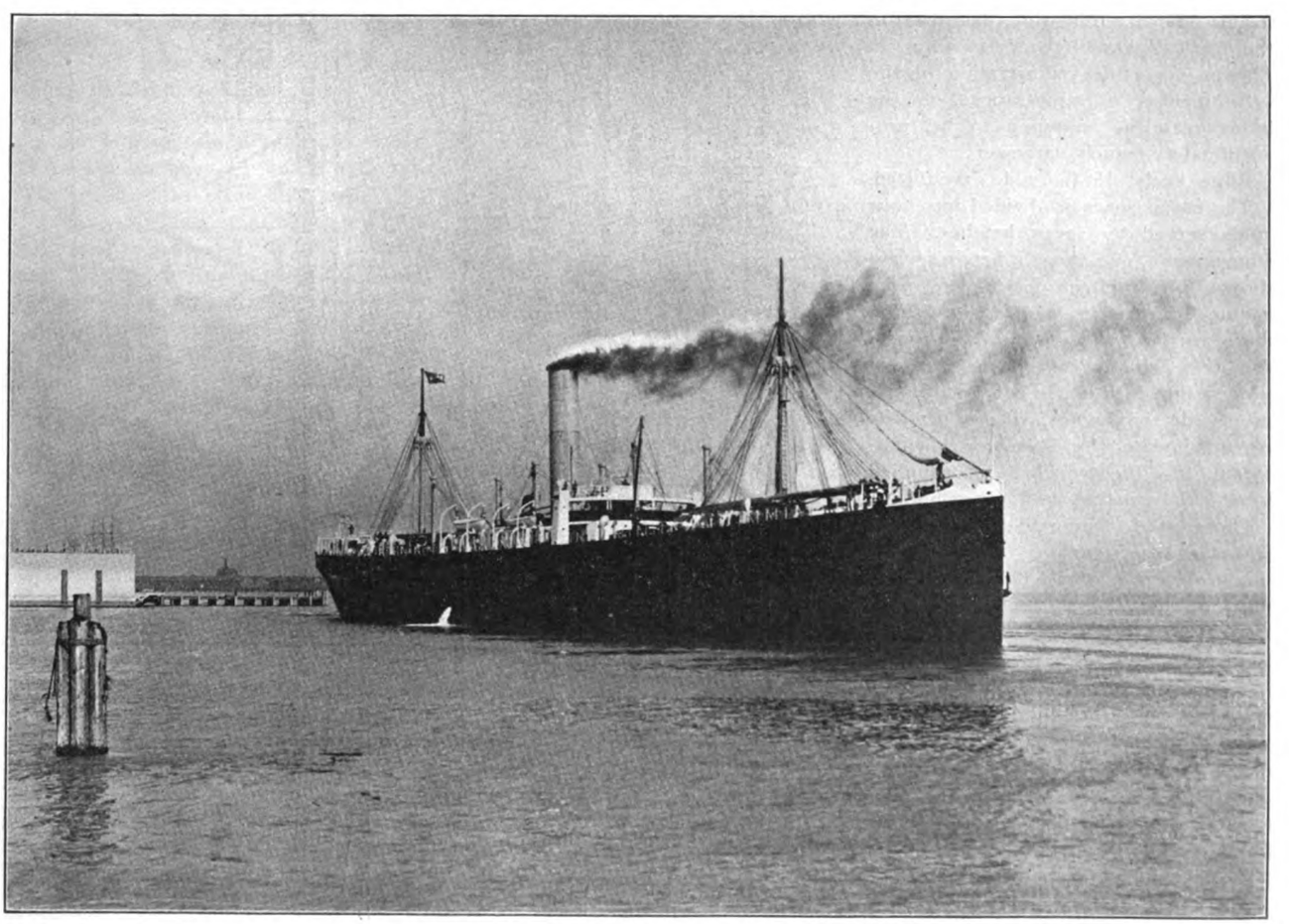
Twin Screw Steel Steamship Columbian

THE twin screw steamship Columbian, built in 1907 by the Union Iron Works Co., at San Francisco and owned by the American-Hawaiian Steamship Co., New York, is one of the best known cargo carriers in the Pacific trade. So far as we know, the details of the construction of this steamer have never been published. We present therefore in this article drawings, photograph and a complete description of the vessel. The Columbian is a sister ship to the Mexican which was built by the Union Iron Works Co. at the same time. The two vessels are identical in construction and both are owned by the American-Hawaiian Steamship Co.

The Columbian is a steel cargo steamer with limited passenger accommodations. In studying her design we should consider her as a freight rather than a passenger steamer. We will look, therefore, for a roomy vessel with ample cargo handling equipment, moderate speed coupled with a long steaming radius,



AMERICAN-HAWAIIAN STEAMSHIP CO.'S TWIN-SCREW STEAMER COLUMBIAN.

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heavy construction and a design which aims toward maximum cargo capacity within the limitations of the vessel.

The hull is 473 ft., 3 in. in length between perpediculars, with a molded beam of 57 ft. The depth of hold is 31 ft., 10 in.; the molded depth to the upper deck is 35 ft. and to the shelter deck is 42 ft., 6 in. The height between decks is 10 ft. The vessel is built according to Lloyds classification No. 100-A. Her summer freeboard is 5 ft., 6½ in. from the main deck; the winter freeboard is 6 ft., 1 in. from the main deck. The length of the double bottom is 422 ft., 6 in.; the breadth and depth of the double bottom are 45 ft., 2 in. and 4 ft., 2 in., respectively. The frame spacing is 26 in. throughout. There are three complete steel decks and one steel orlop deck forward. The sheer is 8 ft., 3½ in. forward and 4 ft. 11 in. aft. The net weight of steel in the vessel is 3,912 tons. With a displacement of 17,800 tons the draught is 29 ft., 6 in. The displacement per inch of immersion is 55.5 tons. The ratio of length to beam is 8.6 and of length to depth 13:1. It is interesting to note that the length divided by the breadth of the Columbian is 8.86 and the same function of the passenger steamer H. B. Kennedy (described in the April MARINE REVIEW) is only 6.8. This is a pertinent illustration of the deceptiveness of appearances, as the latter vessel is supposed to be, proportionately, much narrower.

Bilge keels, 15 in. wide, are fitted.

The cargo space is divided into four holds served by seven hatches. The dimensions of these hatches are shown on shelter deck plan. To handle the cargo to and from the ship there are two masts, four crane posts and two light posts at the forward end of the deck-house carrying in all twenty derrick-booms. These derricks are manipulated by 14 steam winches. Steam for the winches is supplied from either main or donkey boilers.

There are accommodations for 12 first-class passengers besides the ship's officers in the deck house amidships on the shelter deck.

The machinery was built by the Union Iron Works Co. There are two main engines with a total indicated horsepower of 3,600. The cylinders of each engine are 24½, 42 and 65 in. in diameter by 45 in. stroke. The total condensing surface is 7,000 sq. ft. The propellers are 15 ft. in diameter by 17 ft. pitch, and have cast steel hubs and bronze blades.

There are four Scotch boilers in-

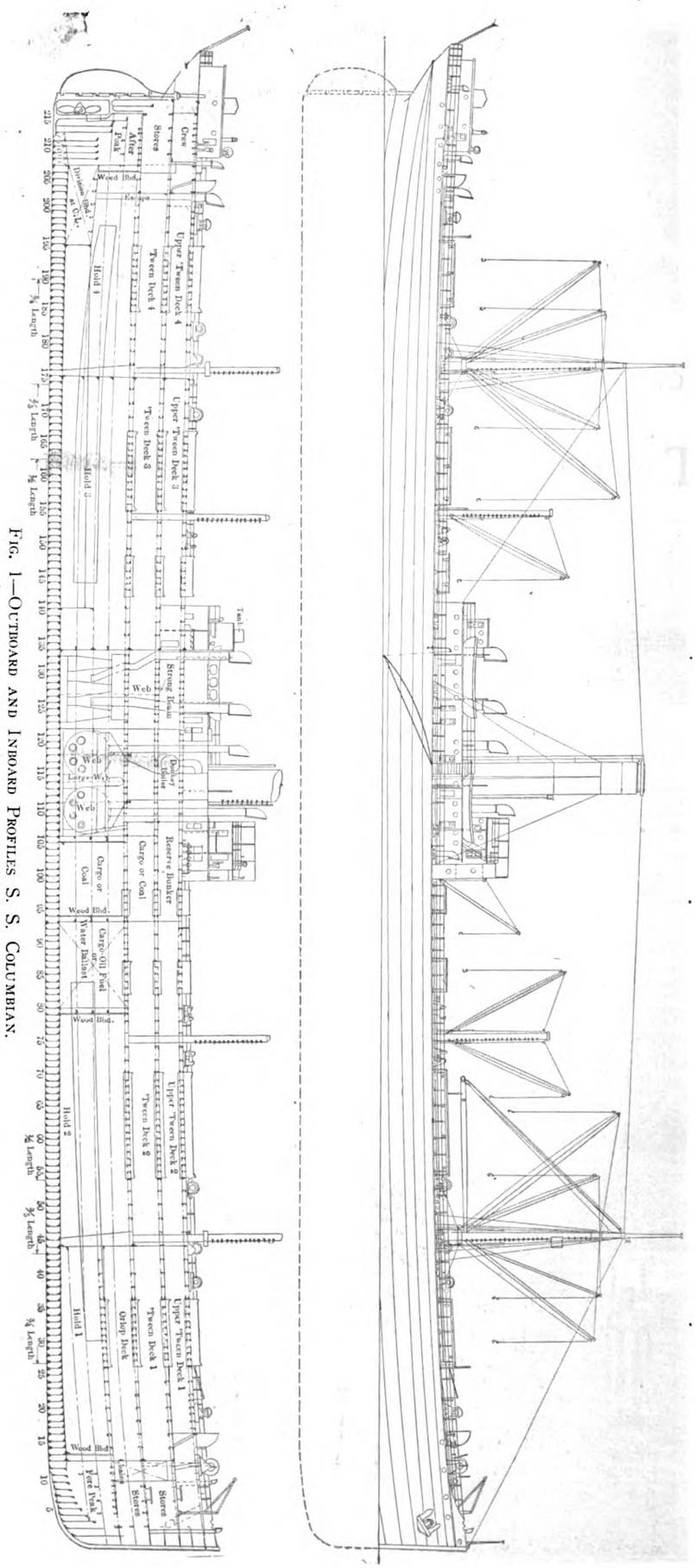

FIG. 1—OUTBOARD AND INBOARD PROFILES S. S. COLUMBIAN.

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stalled with their axes athwartship. The boilers are each 11 ft., 9 in. in length by 15 ft., 6 in. in diameter. The total heating surface is 11,600 sq. ft. and the working pressure is 215 lbs. per sq. in. There are four furnaces, each 37¾ in. diameter in each boiler. The boilers are arranged to burn crude oil fuel and are fitted with the Howden system of forced draught.

The registered tonnage of the Columbian is 8,579 gross and 5,598 net, and her officers and crew number forty-three.

S. S. PATELLA.

The Patella, which has been built by Swan, Hunter & Wigham Richardson, Ltd., Wallsend, for the Anglo-Saxon Petroleum Co., Ltd., London, under the superintendence of their marine department, was taken out to sea on Thursday, May 6, for her trial trip burning coal, her oil-fuel trial having previously taken place.

This vessel, which is similar to the Conch, recently completed by the same builders for this company, is also fitted with all the latest improvements in tank steamers, including Meyer's well known liquid-fuel burning system.

The vessel is of the following dimensions, viz.: 418 ft. overall, by 51 ft. 3 in. beam extreme, by 31 ft. depth moulded, and will carry about 7,700 tons deadweight of oil and bunkers on a moderate draught of water at Loyds' summer freeboard and will take the highest class at Lloyds'.

The propelling machinery, which has been constructed by the Wallsend Slipway & Engineering Co., Ltd., consists of a set of triple expansion engines, with cylinders 26½ in., 43 in. and 72 in. diameters, and 48 in. stroke, and three single-ended boilers working at a pressure of 180 lbs. per sq. in.

On this trial the vessel attained a speed of over 12¼ knots and gave every satisfaction to all concerned. Mr. J. C. Stephens, who represented the Anglo-Saxon Petroleum Co., Ltd., Mr. Crohan, of Messrs. Flannery, Baggallay & Johnson; Mr. C. Stephenson, from the builders' yard, and Mr. G. Campbell, from the Wallsend Slipway & Engineering Co., Ltd., were present.

The vessel proceeded to Port Arthur, Tex., to load her first cargo.

The battleship Danton struck on the ways at Brest, all efforts of tugs failing to move her.

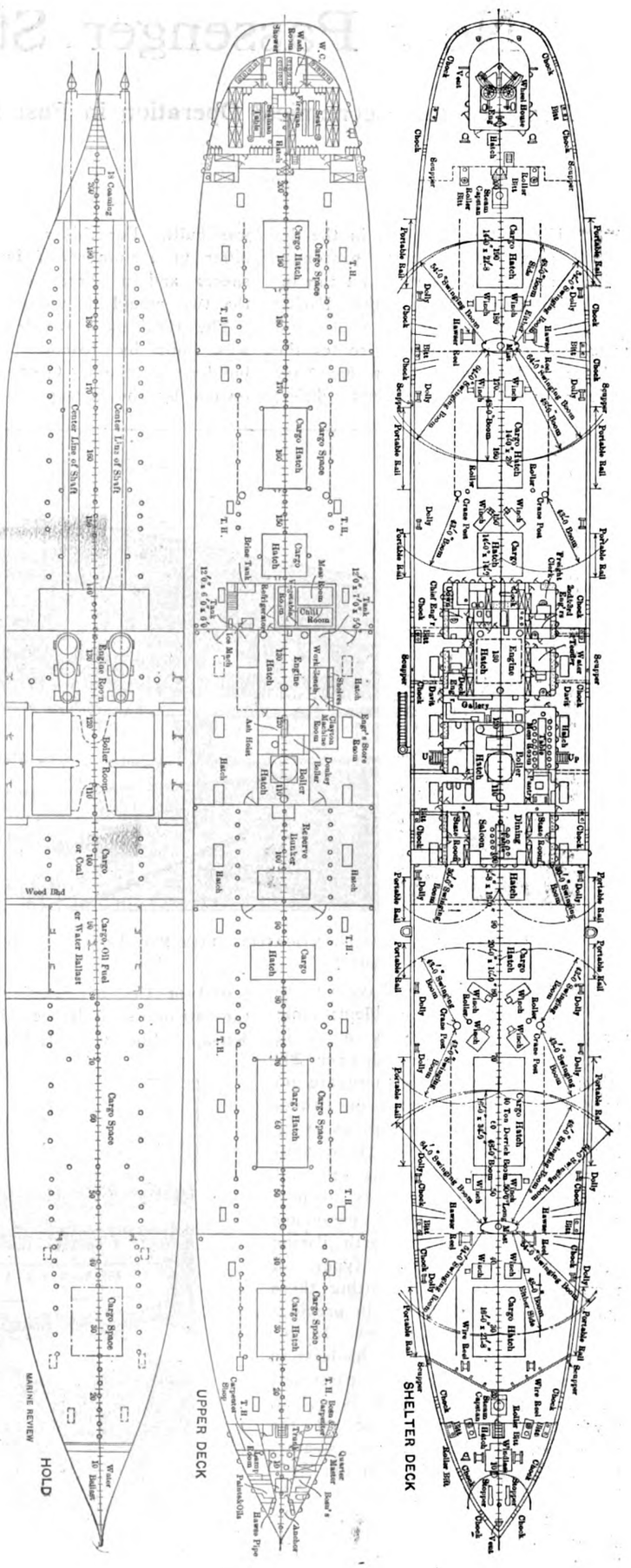

FIG. 2—DECK PLANS S. S. COLUMBIAN.

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New Passenger Steamer Hyak

Designed for Economical Operation in Fast Daylight Service on Puget Sound

By H. Cole Estep

THE factors involved in the design of a fast passenger steamer for service on the inland waters of the Pacific coast are numerous, varied and puzzling. On the different routes the volume and periods of traffic vary widely; weather conditions differ; tides and depth of water have an important bearing on the problem; some runs are only five or six miles in length while others extend over 200 miles; on certain routes there are no stops except at terminals, on others the number of way landings vary from one to thirty. Yet these minutely varying details have a sufficient number of common features to permit the crystallization of passenger steamer designs on the north Pacific into a number of definite types. A number of steamers illustrating these types have been discussed in previous issues of THE MARINE REVIEW. In this article we present for consideration the new Puget Sound passenger steamer Hyak. The Hyak is a fast, daylight steamer belonging to the same general class as the steamer H. B. Kennedy described in the April issue of THE MARINE REVIEW. The service for which the Hyak was designed is not, however, exactly similar to that for which the Kennedy was built. For this reason the boats differ in a number of important respects and a direct comparison of the two would be unfair.

The Hyak is a wooden vessel and was built by Joseph Supple, shipbuilder, Portland, Oregon. She is owned by the Kitsap County Transportation Co. of Seattle, owners of the steamers Reliance, Burton and Kitsap. She was designed by Mr. Supple, with the collaboration of B. F. Morgan, manager of the Kitsap County Transportation Co. Her machinery, including both boiler and engines, was designed and built by the Gas Engine & Power Co. and Chas. L. Seabury & Co., Consolidated, New York.

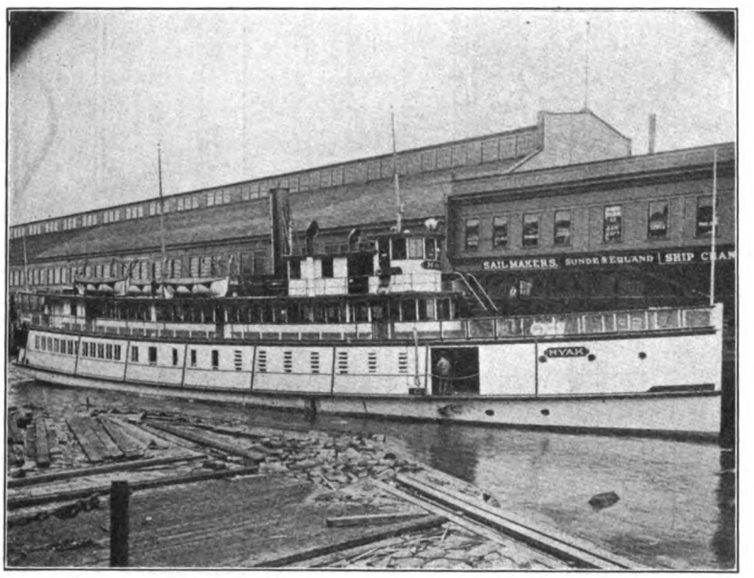

FIG. 1.—STEAMER HYAK IMMEDIATELY AFTER HER ARRIVAL AT SEATTLE.

Design of the Hyak.

In order to thoroughly appreciate the design of the Hyak we must be familiar with the work of the fleet with which she is to be associated. As mentioned above, including the Hyak, the Kitsap County Transportation Co. owns and operates four steamers. The Reliance, which is the oldest of the fleet, was built in 1900; she is 118 ft. in length, 20 ft. beam and 154 gross tons register; she has a speed of 15 miles an hour. The Burton was built in 1905; she is 93 ft. long, 20 ft. beam and 122 gross tons register. Her speed is twelve miles an hour. The Kitsap, which is almost a sister ship to the Hyak, is 127 ft. in length, 22 ft. beam and 195 gross tons register. She was built in 1906. She cost $40,000 and has a speed of 17 miles an hour.

This fleet takes care of the traffic between Seattle and points in Kitsap County located on three separate routes. One route, which includes Harper, Colby, Manchester and other points southwest of Seattle, has a

FIG. 2.—LAUNCHING THE STEAMER HYAK AT PORTLAND, ORE.

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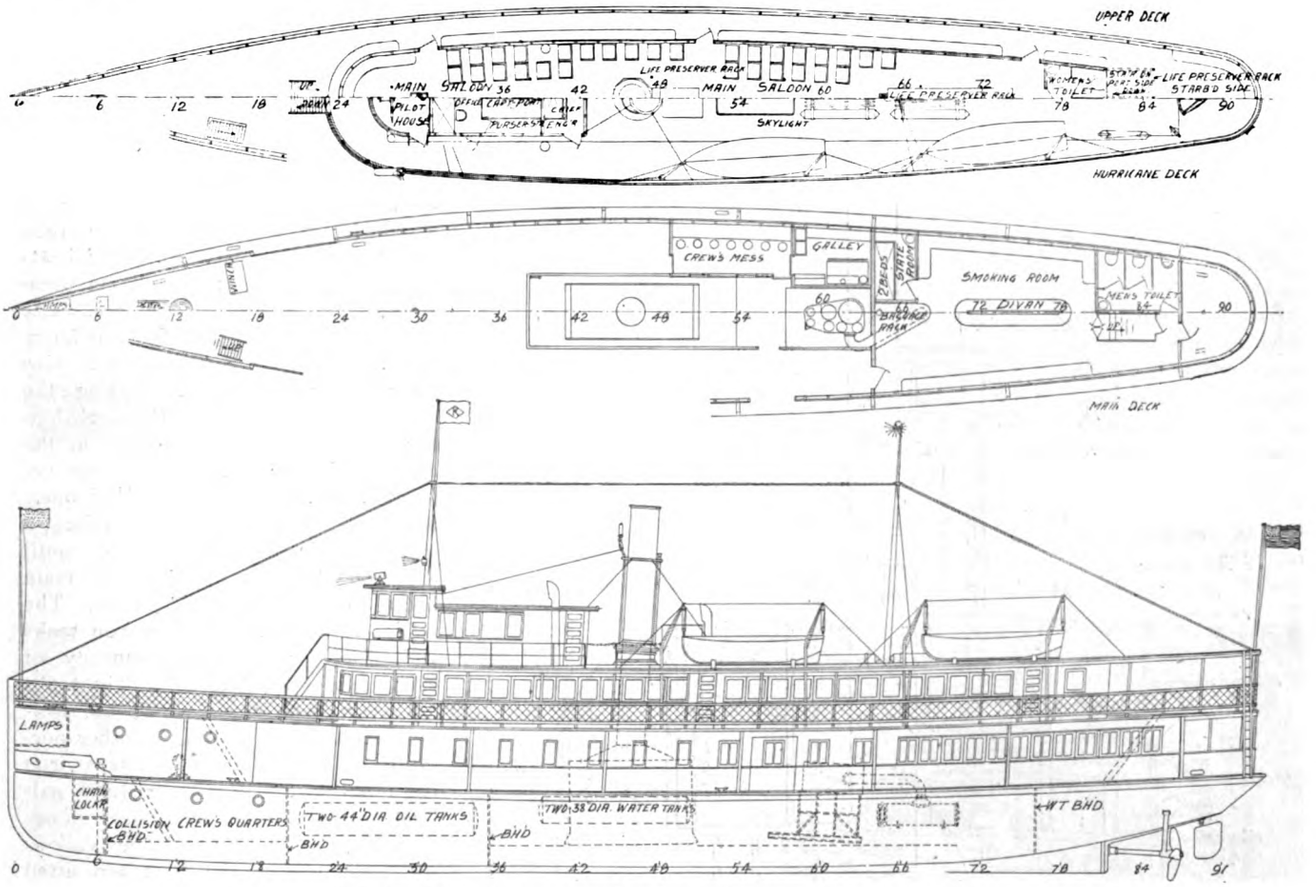

FIG. 3.—DECK PLANS AND OUTBOARD PROFILE OF STEAMER HYAK.

round trip length of 25 miles. Another, known as the Liberty Bay route, includes Rolling Bay, Port Madison, Paulsbo and points northwest of Seattle. The round trip length of this route is 45 miles. The third route is on the west side of Bainbridge island, terminating at Brownsville. The round trip on this route covers 30 miles.

On the Harper-Colby-Manchester route three round trips are provided on week days and four on Sunday. On the Liberty Bay route there are two round trips daily. One round trip daily is furnished to Brownsville and Crystal Springs. The company handles on all routes about 25,000 people per month in summer and 10,000 in winter.

The Hyak was designed particularly for the Colby-Harper-Manchester or the Liberty Bay route. The trips are of medium length, the stops are frequent, the traffic is only moderate, part of the waters traversed are fully protected from storms while the other portions are only partially protected. Tidal variations amount to 12 ft.; tidal currents are strong. The several routes operated by the company differ considerably in character; for this reason the Hyak is a less specialized boat than others which have been designed exclusively for one route. The traffic demands fairly quick service, low fares and careful management. The volume of traffic is only moderate. This combination of conditions —maximum speed, low fares, moderate traffic—presents a very difficult problem to the designer. The boat herself fulfills to a remarkable extent the conditions imposed upon her.

The hull is 140 ft. in length over all, 22 ft. molded beam and 8 ft. deep. The accompanying cross sections, Fig. 4, show the details of construction very clearly. The frames are of double flitch sawed oak, 4½ by 3 in. at the top and 8 by 3 in. at the bottom. The garboard strakes are 4 by 14 and 3 by 12 in., Washington fir. The planking is double. There is an inner skin of ⅝-in. diagonal Port Orford cedar, with outside strakes of 2¼ in. fir. The ceiling is 2¼ in. net thickness. The knees under the main deck are natural bent fir 6 in. thick, the knees under the passenger deck are 2 in. thick. The main deck is planked with 2¼ by 4-in. plank.

The model takes account of both speed and stability. The stern is a modified transom type with free lines which permit quick backing and rapid landings. Two water-tight collision bulkheads are built in the hull, one at the forward bitts and the other just aft of the condenser. There are also two oil tank bulkheads. These divide the hull into five water-tight compartments.

Passenger Accommodations.

Passenger accommodations are provided on the main deck and on the passenger deck above. The main saloon, without partitions from end to end, is situated on the passenger deck. It is furnished with reversible, individual reclining chairs, upholstered in maroon leather. The cabin seats 150 persons. At the aft end of the cabin is the ladies' dressing room, which is unusually large and well equipped. The woodwork is plain, but rich and neat in finish. Outside of the main saloon is a large promenade space. Seats are provided along the gangways and around the stern to accommodate 100 persons. There is also additional room on the deck for 100 portable chairs.

The smoking room, upholstered in rattan, is located aft on the main deck. The crews' mess and galley is amidships on the main deck. The runs are short and no attempt is made to serve meals to passengers. The main deck and passenger decks

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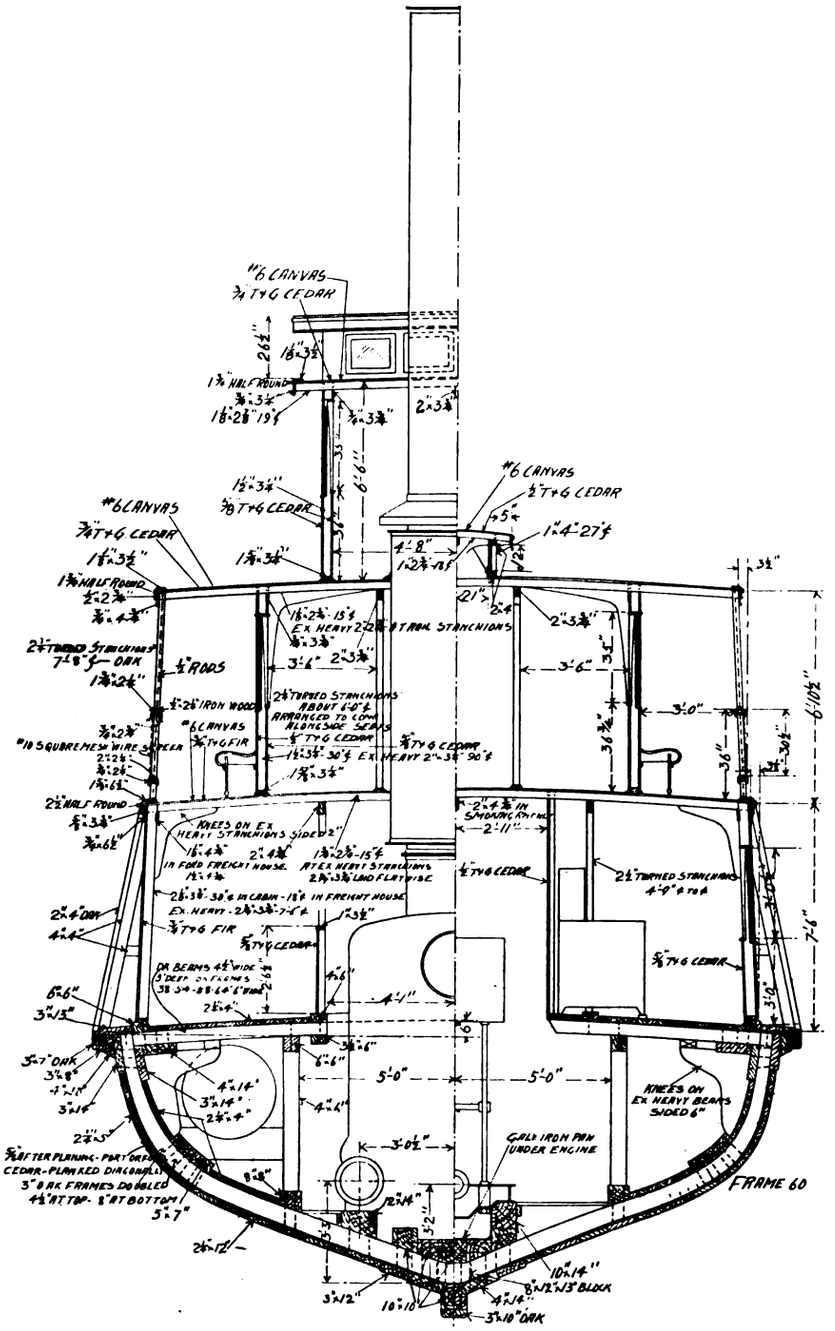

FIG. 4.—CROSS SECTION OF STEAMER HYAK ON FRAMES 48 AND 60.

are connected by two permanent stairways, one forward and one aft.

The pilot house and texas are on the hurricane deck above the main deck. Quarters for the captain and the purser are provided in the texas. The forecastle, containing six roomy berths, is located forward under the main deck. The forecastle has plenty of headroom; it is neatly finished in white enamel paint and is well lighted and ventilated by six 10-in. deadlights.

The passenger deck forward of the cabin and the main deck forward of the boiler is left clear for freight. On the starboard side of the main deck, just forward of the gangway, is an improved, two-cylinder, vertical freight hoist built by the Northwestern Iron Works, Seattle, Wash. This hoist saves considerable manual labor when landing cargoes up steep slips at low tide.

The machinery for the Hyak is a duplicate of that installed in the Kitsap. The engines, boiler and part of the auxiliaries were designed and built by the Gas Engine & Power Co. and Chas. L. Seabury & Co., consolidated, New York. The engine is triple expansion, condensing, of a type designed primarily for first class steam yachts. It has an indicated horsepower of 750. The cylinders are 12, 19½ and 32 in. in diameter by 18 in. stroke. The engine is coupled to an outward thrust bronze propeller manufactured by A. Wells Case & Son, Highland Park, Conn. Steam is supplied by a Seabury water tube boiler which has 3,000 sq. ft. of heating surface and carries a steam pressure of 275 lbs. per square inch. The furnace is provided with four oil burners, two at each end. There is also an auxiliary boiler for starting the oil pumps which spray the fuel into the furnace. The employment of the auxiliary boiler is a distinct improvement over the usual method of operating oil burners, which requires a wood fire in the large furnace until sufficient steam is raised in the main boiler to operate the oil pumps. The oil is stored in two riveted iron tanks which have a combined capacity of 80 barrels or 3,360 gallons. The tanks are in compartments which are isolated by bulkheads from the other portions of the boat. Galvanized iron fresh water tanks holding 1,800 gallons are located in the bilges alongside the boiler room. The various compartments of the boat are fitted with steam siphons of sufficient capacity to fight any ordinary leak.

The rudder is balanced and suspended on the rudder stock, which is carried up to the hurricane deck where the tiller and relief tackles are located. Thus both the main and passenger decks aft of the cabins are left clear. The electric lighting equipment includes a 115-volt direct current generator direct connected to a Fairbanks Morse vertical engine. The boat is brilliantly and tastefully lighted and is equipped with a 3,000 candle power electric search light.

The Hyak has a maximum speed of from 18 to 19 miles an hour and a normal cruising speed of 17 miles an hour. She is an adaptable craft, she has reasonable speed and is small enough to be operated economically. She carries a crew of 12 men. She fulfills the specifications of her owner which require that she have "a model and construction combining activity with carrying capacity, strength with lightness and usefulness with beauty."

It is announced that two Dreadnaughts out of the four provided for in the British naval estimates have been given out. One will be built by Scotts Engineering Co., Ltd., Greenock, and the other by the Palmer Ship Building Co., Ltd., Jarrow-on-Tyne.

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Daring

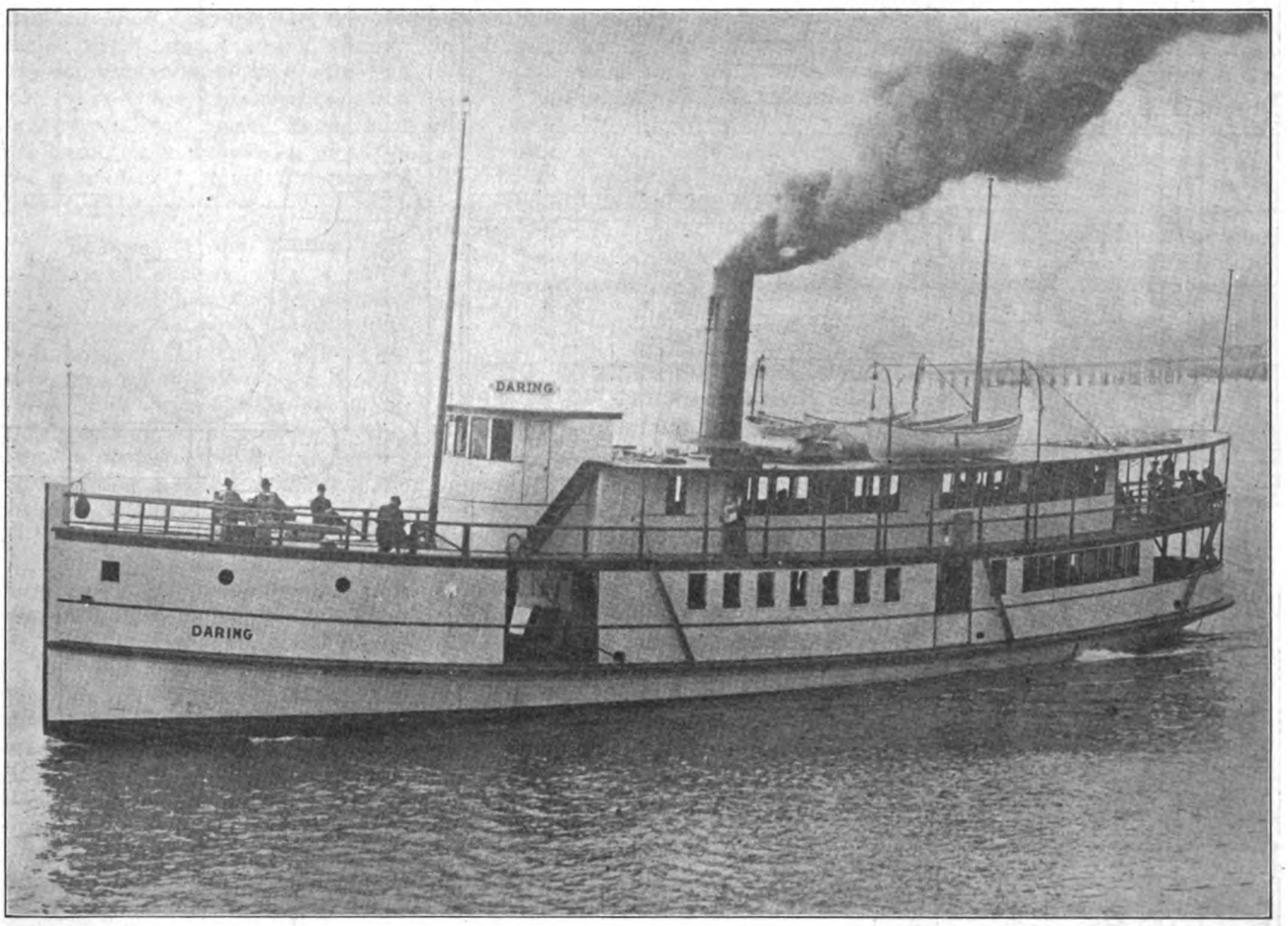
A Small Wooden Passenger Steamer Recently Built on Puget Sound for Local Service Between Seattle and Tacoma

By H. Cole Estep

ONE of the latest additions to the mosquito fleet of Puget Sound is the little passenger steamer Daring. The hull of the Daring was built by Messrs. Crawford & Reid, at Tacoma, the machinery was designed by H. W. Gocher and built by A. F. Hutton, Seattle, while the cabins were built and the steamer was finished by the owner at his private yard at Caledonia Beach, near Tacoma. The Daring is owned by Capt. Mathew McDowell, who also owns the well known steamer Defiance. The Daring was launched with considerable ceremony on Thursday, Jan. 28, 1909. She was towed to Seattle where the machinery was installed. She commenced regular service early in April, 1909.

The Daring operates between Seattle and Tacoma, a distance of 30 miles, stopping at all way ports on both sides of the East Pass. She was built for the same service as the steamer Vashonian, which was fully described in THE MARINE REVIEW, Dec. 3, 1908. The competition between the two boats is very keen. The Daring, while not so roomy or luxuriously furnished as the Vashonian, is a little faster than her larger rival. The Daring is a more economical boat to operate than the Vashonian, but on the other hand she has less capacity. Each boat is doing its work in a thoroughly satisfactory manner and any opinion as to which is the more suitable for the run is purely one of individual judgment.

The types of the two boats are quite different and a comparative study of their principal features is very interesting. The boats were designed for identical service and the comparison illustrates pointedly how widely the conceptions of different designers, who have not had opportunity for collaboration, will vary.



PUGET SOUND STEAMER DARING.

The accompanying table gives the principal dimensions of both steamers.

Ample accommodations are provided on the Daring for 150 daylight passengers. The main saloon is on the passenger deck just abaft of the pilot house. The side seats in this

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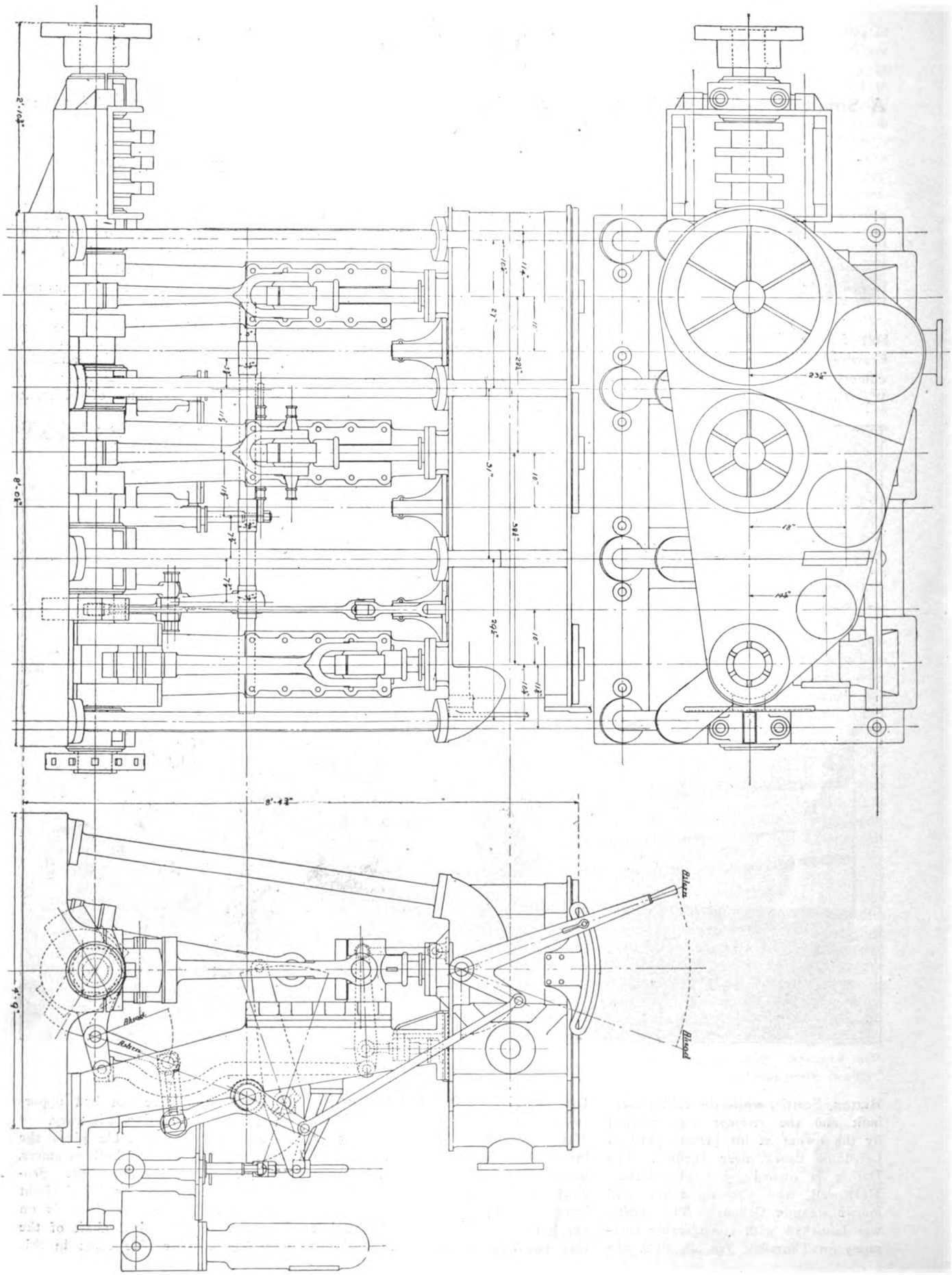

Diagram of Engine of Steamer Daring.

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LEADING PARTICULARS OF DARING AND VASHONIAN.

	Daring.	Vashonian.
Gross tons, register	163	234
Passengers allowed	150	235
Length, over all	110 feet.	125 feet.
Beam, molded	19 feet.	22 feet.
Depth, molded	7 feet.	8 feet.
Engines, triple expansion—		
Diameter of cylinders, in inches	10, 17¼ and 28	12¾, 20 and 33
Stroke, in inches	16	16
Revolutions per minute	180	225
Indicated horsepower	475	650
Valve gear	Marshall modified.	Stephenson link.
Steam pressure	300 pounds.	250 pounds.
Diameter of tail shaft	5½ inches.	6⅜ inches.
Diameter of propeller	78 inches.	82 inches.
Pitch of propeller	120 inches.	110 inches.
Number of passengers per gross ton register	0.92	1.00

cabin are upholstered in leather and in the center of the room is a row of swivel chairs. Passengers sitting in these chairs can swing about and view the scenery on either side of the vessel with ease. The promenade space on either side of the vessel is ample. Aft on the main deck is the smoking room, opening at the extreme stern into a roomy cockpit. The smoking room is fitted with card tables and other conveniences which suggest the club room. Forward of the boiler for a distance of 35 ft. on the main deck is space for carrying freight.

Engines of the Daring.

The main engines were designed by H. W. Gocher, marine engineer, Seattle, and, as noted above, were built by A. F. Hutton, Seattle. They were designed to indicate 475 H. P. at 180 R. P. M., with 300 lbs. per sq. in. boiler pressure. The engine is very compact, being only 8 ft. long, 4 ft. 9 in. wide and 8 ft. 4¼ in. high. The floor space occupied by the engine is 38 sq. ft. In order to get this compact arrangement a slightly modified form of the Marshall valve gear was adopted instead of the usual Stephenson link motion. The arrangement of this gear and the relations of the links are clearly shown in the end view in the accompanying drawing of the engine. This design of valve gear saves 3 ft. of fore-and-aft space in the engine room and provides a sharp, quick, adjustable cut-off.

The thrust bearing is of the common horseshoe type, with three yokes and collars 12½ in. in diameter. The frame of the thrust bearing is cast solid with the bed plate of the engine, thus insuring rigidity and permanent alignment.

Steam is generated in a Taylor water tube boiler with 1,800 sq. ft. of heating surface. The boiler burns coal. The bunkers have a capacity of 20 tons. The average fuel consumption when the engine is indicating about 300 H. P. is at the rate of 600 lbs. per hour. The ordinary speed of the boat is from 14.5 to 16 statute miles per hour, with sufficient reserve power to increase the speed to 16½ or 17 miles per hour.

The surface condenser was built locally and has 600 sq. ft. of cooling surface. The average vacuum maintained is 26 in. The condenser is fitted with a 5 x 5 in. centrifugal circulating pump. The pump has an 8-in. suction and was built by the Morris Machine Works, Baldwinsville, N. Y.

The little steamer is very staunchly built and while she has not yet been severely tested she has been through enough rough weather to prove that she is perfectly safe on the semi-protected waters of Puget Sound.

POKING FUN AT GERMAN INVASION OF GREAT BRITAIN.

Speaking at the annual dinner of The British Iron and Steel Institute, on May 14, 1909, Sir William Ramsay regretted that so much metal was used for purposes of destruction. Sir Hugh Bell, president, in referring to the naval scare, regretted that so much of their material was used for engines of war, but he still claimed that on the whole their exertions made for peace. It was curious, he said, that when they sent a Dreadnought into the sea, the one prayer that went up as the huge ship slipped into the ocean, was that it might never be put to the use for which it was intended. It was sad that after 1900 years of Christianity, it was found upon looking over the globe, that all nations stood at arms ready to fly at each others' throats.

He recently crossed many thousand miles of the Atlantic ocean to find a continent much larger than Europe, tenanted by 70 or 80 millions of people with adequate space for any development, and where one would have thought their main enterprise would be the development of their magnificent resources, yet found it urged continually that this country and the other countries were building Dreadnoughts, and it was therefore necessary that they should be able, when the time came, to attack their neighbors.

Personally he had never been able to feel any jealousy of a foreigner's prosperity, because whether he was an Englishman, American or German, his prosperity could not fail to contribute to that of other nations; he rejoiced, therefore, to see the growing enterprise of America, Germany and France, because, however wrong-headed they might be, they cannot help benefiting other people. If those sentiments prevailed everywhere throughout the world, it would no longer be necessary to build Dreadnoughts, and Great Britain would not set aside £80,000,000 of money per year for war purposes which should be applied to the useful arts of peace. Above all things, they should avoid panic, for which, as Sir William White and Admiral Fisher often told them, there was not the slightest ground.

Sir Hugh's remarks remind us of the story of the British juryman who held out against the united opinion of his 11 fellow members and insisted that they were 11 of the most persistently wrong-headed people he had ever seen. Another amusing incident connected with the recent prevalent war scare in Great Britain was brought out by Major Baden-Powell, who provoked a peal of laughter at the expense of the panic-mongers who were always predicting German invasion and could not sleep at night for fear of spies. It was said that Germany had a complete knowledge of every town and village on the east coast, even the names of the village postmasters. A German officer, with whom he was conversing some time ago, admitted this to be true and when the major asked "however did you get the information," replied, "Oh, we took the trouble to buy for 10 shillings and sixpence a copy of Kelley's directory."

The Montreal harbor commission has given out the details of the plans for a floating dry dock to be built at that port. The capital, $2,500,000, has been raised in Great Britain. The Dominion government is to expend $1,500,000 in the creation of a suitable site and to lease the same for a term of years to the company at a nominal rental. The dock will accommodate vessels of 25,000 tons. The whole work of construction is to be completed within two years.

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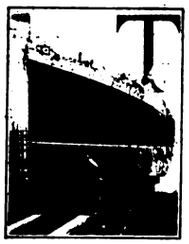
THE "ATLANTIC GREYHOUND."

By Frank A. Smith, Sixth Engineer S. S. Lusitania.



THE average passenger crossing the Western Ocean in our express trans-Atlantic liners is little aware of the debt they owe to engineers for their ability and untiring energy in placing at their disposal and maintaining under all conditions such triumphs of marine architecture in speed and comfort as we have today.

The days of the well-decked and hurricane-decked steamers are past; there is something more demanded nowadays from ship builders.

The fast ships steaming across the Atlantic at 25 knots per hour are nothing wonderful, seeing the immense power applied to their four screw propellers. Suppose the vessel had not steamed at that high rate of speed, then there would have been something to wonder about, and a power loss to account for; the result is a mere matter of calculation and nothing more.

The question is frequently asked: why build these floating palaces; and is it necessary to drive them at such a speed? Comparisons are odious, but the following will illustrate: Take the four-wheeler cab that is seen in the streets of our large cities, dragged along by a quadruped that has seen better days and driven by a biped looking equally miserable, at a pace of say five miles an hour, and the fare demanded is in keeping. Take again a carriage drawn by a pair of spanking horses doing their utmost in speed, driven by a dashing coachman; then the express speed has to be paid for. Just in the same way is the so-called ocean tramp steamer a comparison with the ocean greyhound. So long as passengers are willing to pay handsomely for express passages and increased comforts, the shipowner will always come forward to meet their requirements; it is all a matter of business.

Distribution of the Crew.

The crew of one of the fast ships number over eight hundred, viz., deck department, 70; steward department, 350; engine department, 384. Taking this into consideration and the value of the ship, the mails, and a full complement of passengers, having command is no sinecure, and all on board wish the commander well and a speedy journey across the Atlantic.

At certain times of the year more or less fog prevails, which causes great anxiety, and at these times the question of risk has to receive the most serious consideration. With every attention exercised to discover and avoid danger, and fitted with the most improved detector bells and electric sounding machines, the vessel, although going at a high rate of speed, is under perfect control, and thus diminishes danger of accident to all those "who go down to the sea in ships."

The navigating officers who take charge of the bridge and deck, receive their early training on board other ships, and passing in all the different grades, are qualified to take a command before entering the company's service. In winter months, posted on the bridge sixty feet above the sea level, exposed to all weathers, driving into the storm in the watches of the night, their straining eyes lashed by the sleet and wind, the officers of this section of the mercantile marine exhibit courage and valor of as heroic a character as ever adorned the pages of history; and that gentlemanly courtesy which is by no means confined to the drawing rooms of the wealthy.

The catering department have to cope with the stupendous task of looking after the gastronomic welfare and accommodation of upwards of three thousand souls, providing the food for several nationalities in a manner that compares favorably with the most fashionable and best equipped hotels.

Examining the Engine Room.

One day is set apart for the passengers to examine the heart of the mystery of these speeding monsters and to enter the sacred precincts of the engine room—one huge box of machinery.

Steam is generated in 25 boilers of the Scotch type, placed in four separate water-tight compartments or boiler rooms. The boilers are fitted with Howden's improved forced draft, and consume 1,000 tons of coal per day. The coal has to be passed from the bunkers which line the sides of the ship to the furnaces, which number 192.

This department gives employment to a class of men which is a case of "survival of the fittest," a material at times very difficult to handle, and when handled successfully, so much to the good. The work done by these men is most hazardous; smoke, dust and sulphurous atmosphere to labor in, and no one knows he is on board ship until the stokehold is seen. It must be remembered that firemen and coal trimmers are much like other men; they cannot accomplish much more work than the majority of other workmen and are not altogether the underground savages that some people apparently consider them.

The crew under the chief engineer are divided into three watches, i. e., four hours on duty and eight hours off duty.

Compare the turbine engine of today with the compound engine of a few years back. We will take a compound engine of say 5,000 H. P.; the complement of engineers were seven; 14,000 H. P., complement 10 engineers; twin-screw 28,000 H. P., twenty-two engineers; present day, 70,000 H. P., thirty-one engineers. So much for the turbine of the present time, the largest plant afloat. Again, supposing reciprocating engines were used developing the same horsepower, the lubrication for the internal rubbing surfaces would have to be used in such quantities, that it would be a great danger to the heating surfaces of our boilers, even with the best known filtering apparatus for the feed water; such a plant on board ship would be impossible to run with the minimum of risk in comparison with the turbine.

Papers have been read recently by our foremost engineers which show that, taking into consideration the displacement, speed and consumption of coal, there is nothing to compare with the turbine for this class of ship and that this type of motor has come to stay.

Duties of the Chief Engineer.

The chief engineer is held responsible for all the machinery on board. Apart from the main engines, the auxiliary machinery includes the following: windlass gear for heaving the anchor, capstans, warping engines, winches and steering gear, refrigerating and condensing plant, air, circulating, feed, fresh water, sanitary and other pumps, and miles of piping of all sizes. The electric plant alone is capable of supplying power sufficient for a town of 20,000 inhabitants. Fans supplying air to the different parts of the ship for ventilating purposes are all motor driven, and the air being regulated in temperature before entering the compartment, serves the double purpose of being used for both heat and ventilation. This system also comes under the chief engineer's

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care. There are over eighty auxiliary engines on board, besides an extensive plant in connection with the water tight doors, 37 in number, controlled from the bridge. All water tight doors can be closed in an instant in case of accident.

Great credit is due to the designers of these wonderful monuments of naval architecture, by whom the best of material and workmanship possible to obtain were secured to place success beyond all doubt. The whole civilized world scan their newspapers and converse gibly of these ships and their much vaunted records without ever a thought for the men who are creating them—the marine engineers, who being out of sight are likewise out of mind. The chief engineer and his staff have no time for attitudinizing on deck like old "Bettys" and worrying night and day for fear their ship will go to the bottom of the sea. There is no necessity for such a want of confidence, because in the construction of these ships what is aimed at is absolute perfection. The enterprising newspaper man sometimes gets aboard, and is usually misleading in his statements, apparently believing that marine engineers are but shovelers of coal and slingers of oil; men who are most illiterate, rude of speech and boorish in manners, but it must be admitted that such ignorant criticism affords much amusement.

The engine department, although having so much under their control, are always capable of keeping the machinery running and doing the necessary overhauling in port, making ready for another voyage, and when breakdowns do occur, are always sufficiently resourceful to complete the voyage in safety—this is what no other department on board can boast of.

It must be admitted that the engineers are a most important and deserving section of the personnel of the merchant marine and to whom the nation is indebted for much of its material prosperity.

LADDER DREDGE OPERATED BY A PRODUCER GAS ENGINE.

The Faris-Kesl Construction Co., Boise, Idaho, are operating on drainage work a ladder dredge having buckets of 9 cu. ft. capacity driven by a 150-H. P. producer gas engine, operating on pea size anthracite coal. The connections to the various parts of machinery are through a belt from the engine to a line shaft, thence by sprocket chains to various counter shafts driving the digging ladder, hoisting and swinging winches, etc. The digging ladder has 66 buckets pitched 26 in., center to center, and the conveyors are of the metal pan type, 85 ft. center to center.

STEAMER ROBERT FULTON LEAVING FOR HER BUILDERS' TRIAL TRIP.

STEAMER ROBERT FULTON.

Herewith is published a photograph of the steamer Robert Fulton of the Hudson River Day Line on the 116th day after the first plate of the keel was laid at the yard of the New York Ship Building Co., Camden, N. J. Exactly 126 days from the laying of the keel the boat started to New York under her own steam unattended. The steamer was designed for a speed of 23 miles an hour. For a whole hour on her maiden trip she made 24 miles an hour. She was very steady enroute to New York, around the capes of the Delaware. She cuts the water beautifully and raises very little swell in the shallow channels in the upper reaches of the Hudson. She was designed by Frank E. Kirby, consulting engineer, and J. W. Millard, naval architect. E. E. Olcott, president and general manager of the Hudson River Day Line, says that the company considers her in every way the greatest possible success.

The principal dimensions of the Robert Fulton are: Length over hull, molded, 346 ft.; breadth of hull, molded, 42 ft.; breadth over guards, molded, 76 ft.; depth, base line to top of deck beams at side of hull at lowest point of sheer, 12 ft. 4 in. The Fulton is fitted with a beam engine 75 in. diameter of cylinder by 12 ft. stroke, driving feathering paddle wheels 30 ft. in diameter.

The board of trade of St. John, N. B., has just put out an attractive statement of the export trade of that port. During the six months beginning November, 1908, and ending May, 1909, the exports amounted to $24,564,840. As showing the relative growth of the port of St. John its export trade in 1898 amounted to $7,063,992 as compared with $61,117,703 for Montreal. Its trade last year was $20,668,517.

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Marine Steam Turbines

THERE is a widespread idea that the turbine can be efficiently applied to a very wide range of merchant work. Actually this is not so, and its superiority for anything but a very limited class of work has yet to be proved.

This is, of course, quite contrary to the popularly accepted idea, so that it will be necessary to justify this statement. In order to systematize the discussion let us recapitulate some of the advantages claimed for the turbine system when applied to merchant vessels. They are principally:—(1) Increase in economy; (2) saving in weight; (3) saving in space; (4) saving in oil and attendance; (5) absence of vibration.

Considering (1) economy, it will be readily recognized that this is a point of vital importance in the merchant service, and it is doubtful whether any other consideration can properly compensate for any deficiency in this direction. That the turbine itself is generally superior to the piston engine as regards economy is universally conceded. On the other hand, what concerns the ship owner is not the efficiency of the turbine alone, but the combined efficiency of turbine and propeller. Thus the important consideration to the ship owner is not the consumption of steam per hour per shaft horsepower developed by the turbine, but the consumption per effective horsepower. The effective horsepower is that portion of the total horsepower which is usefully employed in propelling the ship and which corresponds with the actual propeller thrust.

Steam Consumption Per Shaft Horsepower.

Leaving out the question of propeller efficiency for the moment, let us consider a few figures relating to steam consumption per horsepower per hour. The results of numerous trials of turbine-driven vessels indicate that this consumption varies very little from 14 lbs. to 15 lbs. for all purposes. These figures apply to all classes of marine steam turbines with the exception of those fitted to torpedo craft, in which it is rather higher. With the piston engine, on the other hand, the steam consumption per shaft horsepower varies very widely with the type of vessel. Assuming the mechanical efficiency of the engine to be from 93 to 95 per cent, the figure for high speed cross-Channel steamers would be from 18.5 lbs. to 20.5 lbs. In high speed ocean liners it would be about 15.25 lbs. to 16.5 lbs., and for the slower speed liners of, say, less than 22 knots, the figure for their highly efficient piston engines would be from 14.75 lbs. to 15.75 lbs., while in the ordinary cargo tramp it amounts to from 15 lbs. to 15.75 lbs. As regards the reciprocating engines of naval vessels, the corresponding consumption for battleships and the heavier classes of cruisers would be from 19 lbs. to 20 lbs., and about 21 lbs. to 22 lbs. for the lighter cruisers, scouts and torpedo craft. Thus it would appear that the turbine considered alone is decidedly superior in economy to the reciprocating engines of naval vessels and high speed cross-Channel steamers; the advantage is only slight in the case of racing liners, while there is little to choose between the two types when applied to the slower speed "intermediate" liners.

Misleading Comparisons.

Now the only published comparisons between the two systems relate to third-class cruisers and cross-Channel steamers, and show a remarkable saving in favor of the turbine. On the other hand—as the above figures indicate—the piston engines fitted to third-class cruisers are extremely uneconomical, and the same remark applies to those in high-speed cross-Channel steamers, so that the vessels compared are of the types most unfavorable to the reciprocating engine. It would seem, then, that any general deductions from the results of such comparative trials are very misleading and manifestly unfair to the older system. Thus it must be conceded that the results of a comparison between turbines with a consumption of steam per shaft horsepower per hour of 14.5 lbs., and the reciprocating engines of third-class cruisers, with a consumption of 21 lbs., cannot be expected to apply in the case of, say, an ocean liner of the intermediate type, in which case the consumption with turbines may be 14.25 lbs., and that of corresponding piston engines 15 lbs.

Propeller Efficiency.

Now, let us go a step further, and take propeller efficiency into our calculations. It is obvious that the comparison of steam consumptions per shaft horsepower is of little practical value, as it takes no account whatever of propeller efficiency. What is required to make a true estimate of the relative economy of the two systems is the steam consumption per effective horsepower per hour for every type of vessel. A better word, perhaps, for effective horsepower would be thrust horsepower, as it is the horsepower corresponding with the actual propeller thrust. Thus it would seem that a more rational method of comparing marine steam turbine performance would be by means of the actual thrust produced rather than by the shaft horsepower, as the latter figure only represents an intermediate stage in the transformation. Thus it is of little assistance to know that a set of turbines is developing 20,000 shaft horsepower while we are absolutely in the dark as to whether the thrust horsepower—that portion usefully employed in propelling the ship—is 8,000 or 10,000.

There can be no doubt whatever that the high-speed propellers with fine pitch ratios that are required for turbine-driven vessels are much less efficient than the slower running screws used with piston engines. In every instance it has been found that the shaft horsepower as measured by the torsionmeter is considerably in excess of the indicated horsepower necessary to produce the same speed with reciprocating engines. Thus the writer remembers the case of a turbine-driven vessel which was expected to attain the required speed with 6,500 horsepower, this figure being estimated from the performance of similar vessels fitted with piston engines. The actual speed obtained fell somewhat short of that anticipated, and a torsionmeter was then fitted. The shaft horsepower, as measured by the torsionmeter, was found to be 8,500 instead of the 6,500 expected.

Again, whereas the shaft horsepower of the Tribal class of 33-knot destroyers was estimated from reciprocating engined vessels to be 15,000 the actual shaft horsepower necessary was over 20,000. In the 26-knot Coastal torpedo boats the horsepower is nominally 4,000, while actually over 5,000 is required. In the absence of any apparatus for measuring actual propeller thrust it is by such comparisons, or by calculating

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the effective horsepower required from the results of tank experiments, that we are able to estimate the efficiency of turbine-driven propellers. The figures for propeller efficiency obtained from the trials of model propellers working in undisturbed water are almost valueless when applied to actual practice.

Efficiency of Mauretania's Propellers.

In the case of the Mauretania, although the propellers were very carefully designed, and are the result of long and elaborate experiments and comparisons, it is doubtful if their efficiency is over 52 per cent. The efficiency of the Lusitania's propellers has been given as 48 per cent, and it must be remembered that these screws are working under conditions very favorable to the turbine propeller.

The efficiency of the propellers fitted to turbine cross-Channel steamers may vary from 48 to 52 per cent, while those of turbine-driven torpedo boats and destroyers cannot be much more that from 45 to 48 per cent efficiency.

Let us compare these figures with the efficiencies obtained with the slower running screws of reciprocating-engined vessels. Here the efficiency may be said to vary from 60 to 66 per cent in most cases, only dropping much below 60 per cent in the case of the bluff-sterned single screw cargo tramps, in which case it may be as low as 55 per cent. With the assistance of these figures we can estimate approximately the steam consumption per thrust horsepower per hour, and so obtain a truer comparison as regards the economy of the two systems.

Naval or merchant vessels.	Type of vessel.	Turbines or recip. engines.	Steam per shaft horsepower per hour. Lb.	Propeller efficiency. Per cent.	Steam per thrust horsepower per hour. Lb.
Naval vessels..	Battleships and large cruisers	Turbines	14.5	50	29
		Recip. engines...	19.5	60	32.5
	Small cruisers and scouts	Turbines	14.5	50	29
		Recip. engines...	21	60	35
	Torpedo craft	Turbines	16	47	34
		Recip. engines...	21.5	60	36
Merchant vessels.....	High-speed cross-Channel steamers	Turbines	14.5	50	29
		Recip. engines...	19.5	60	32.5
	High-speed ocean liners	Turbines	14	52	27
		Recip. engines...	15.875	64	24.8
	Intermediate ocean liners	Turbines	14.25	52	27.5
		Recip. engines...	15.25	65	23.5

The above table is rather instructive as indicating the limit which the high-speed propeller sets to the efficient application of the turbine system. Of course, the figures in the table are necessarily approximate, but they represent fair averages, and it must be conceded that considerable modifications would be necessary to affect the general conclusions.

Turbine and Naval Vessels.

As regards the machinery of naval vessels the table shows a marked superiority for the turbine system with reference to economy. Thus the increase in steam consumption with reciprocating engines would appear to be about 14 per cent with battleships and the heavier classes of cruisers, and as much as 20 per cent with the lighter and less efficient engines of small cruisers and scouts; while as regards torpedo craft the turbine system is only slightly more economical. In other respects also the steam turbine is admirably suited to the requirements of naval work.

It requires very little attention and no great skill in operating, qualities which may be of great importance in action, and also in view of the frequent changes in the engine room staff. Full power can be easily maintained with the turbine, whereas, in the piston engines fitted to the latter classes of warships the bearing surfaces were generally deficient, and very careful attention on the part of a numerous staff was necessary at anything approaching full speed, while very gradual working up was essential. Another quality of the turbine which is of great importance in naval work is its suitability for working at any proportion of full power. On the other hand, the piston engine shows to best advantage when worked at one unvarying speed. When all these considerations are taken in conjunction with the advantage of lying very low in the ship, the overwhelming superiority of a turbine system for this class of work cannot be questioned. With regard to merchant vessels, however, the situation would appear to be very different. The table shows the turbine system to considerable advantage when applied to high-speed cross-Channel steamers, and actual practice supports this conclusion. In this case the table indicates an increase of 12 per cent in the steam consumption when piston engines are adopted.

Steam Consumption on Racing Liners.

On the other hand, when we consider the case of high-speed racing liners, it would seem that the consumption of steam per thrust horsepower is about 9 per cent greater when turbines are fitted, so that the advisability of applying turbines to this class of vessel appears somewhat doubtful. Again, in comparison with the highly efficient reciprocating engines of the intermediate type of ocean liner, the turbine system appears distinctly inferior in economy as the increase in steam consumption when turbines are adopted appears to be about 17 per cent.

There seems to be considerable reason to believe that this conclusion is supported by the actual results obtained with turbine vessels of this class. Thus there exists little doubt in the minds of many engineers that better results with reduced expenses would have resulted had piston engines been fitted in the express Cunarders. Again, a significant silence is maintained regarding the performance of the slower-speed turbine liners, and there are persistent reports of excessive coal consumption. In this connection a comparison of the coal consumption of the Carmania with that of her reciprocating-engined sister Caronia would be very interesting, and possibly instructive. Apart from the question of economy, the turbine is not seen in so favorable light when compared with the piston engines of the ocean liner.

With ample bearing surfaces no great difficulty is experienced in maintaining full speed with this type of engine. Again, the speed remains practically unaltered when at sea—a condition which shows the reciprocating engine at its best. On the other hand the turbine is a very much simpler machine. The wearing parts are very few and the wear scarcely perceptible. The lubrication is automatic, so that a considerable saving in attention and oil must result. Then, as the wearing parts are few, the depreciation with the turbine should be very slight. The point to be considered is whether these advantages can compensate for an increase of from 9 to 17 per cent on the coal bill.

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Relative Weight and Space.

In the early days of the turbine a great deal was said and written about the saving in weight and space consequent on its adoption. Actually there is a valuable saving in weight in the case of high-speed cross-Channel steamers, and generally also with naval vessels, though not to the same extent. In torpedo craft there is little to choose betwen the systems in this respect. The weight of the turbine machinery of the Mauritania and Lusitania is practically the same as that of corresponding piston engines, and this has generally been the case whenever turbines have been applied to the heavier classes of vessels in the merchant service. The reason of this is that in such vessels, in order to keep the number of revolutions per minute low and so assist the propeller efficiency, it is necessary to make the turbines as large as circumstances will permit. Thus it may be said that, in all cases except high-speed cross-channel steamers and naval vessels, the weight is generally about the same; but on the other hand the space required is generally greater when turbines are adopted. This increase in space may amount to as much as 25 per cent.

The Question of Vibration.

As far as absence of vibration is concerned, there is not a great deal to choose between the systems when applied to merchant vessels, as a well balanced four-crank engine will run with very little vibration. Although, generally, turbine-driven vessels are slightly superior in this respect, there are a fair number in service in which vibration is rather severe. Thus in the express Cunarders there is or was considerable vibration in the vicinity of the wing propellers, and there are several cross-channel steamers in which in certain parts of the ship it is distinctly unpleasant.

This vibration in turbine vessels is almost entirely due to the propellers. Even the most careful balancing cannot remove it, because, when the propellers are arranged to run close up to the ship's side, as each blade passes through the faster moving wake close to the ship's skin the center of effort of the propeller is moved. Thus a succession of shocks is produced. The use of specially shaped propeller blades may reduce the evil, but the most effectual way is to arrange the propellers at a good distance from the skin of the ship. This involves a loss of efficiency, as, by placing the propellers in the fast-running wake against the ship's side some of the work which has been expended in putting the wake into motion is regained in the form of additional thrust. Freedom from breakdown is another point with regard to which the two systems may be compared. The reciprocating engines fitted to mail and intermediate liners are very free from breakdown, and one would suppose that the same might be said of a well designed and constructed turbine. However, quite a large number of turbine vessels have suffered from blading strips or had their dummies carried away. Of course, such happenings are not advertised, but a complete list of such mishaps would surprise the outsider. Thus faulty brazing was the cause of an extensive strip in one notable case, whilst an un-mechanical method of rotor construction produced the same result in another; a too flexible design of rotor wheel caused the dummies to be carried away in other cases; and in another an almost complete strip was caused by opening the regulator too suddenly.

The list could be extended to a greater length, but it must be admitted that the majority of these mishaps occurred from inexperience both in design and operation. On the other hand, it is somewhat discouraging to hear that the turbines of one of our recent second-class cruisers stripped their blading when being tried under steam in the works, in spite of the fact that the latest type of segmental blading was adopted. However, there can be little doubt that in time, as more experience is gained, such turbine troubles will become very rare.

Overhauls and Renewals.

It is difficult to conceive of any breakdown to a reciprocating engine which cannot be overcome at sea. But a serious strip in a turbine would take a very long time to repair, and it is very doubtful if re-blading could be carried out at sea at all. On the other hand, it is scarcely likely that all the shafts would be put out of action at the same time.

Again, it is possible to subject a piston engine to a complete examination at the terminal ports, and such an examination must do much to secure immunity from accident. With the heavier class of turbine machinery this is not possible, as the opening out necessary for a complete examination would entail a great deal of time and labor. It must be admitted, however, that in the reciprocating engine there is a vast number of bearings and wearing parts which are constantly requiring adjustment or renewal. The wear and tear with the turbine is practically nil, and the work of the shore gang must be greatly reduced by its adoption. Again, if we could rely on the blading and dummies remaining intact it would only be necessary to open up the turbines at long intervals. On the other hand, it ought not to be forgotten that very expensive overhauls and renewals have been necessary with several turbine vessels.

To sum up our comparisons, it is evident that the turbine system is decidedly superior for all classes of naval vessels, and also for high-speed cross-channel steamers.

With regard to high-speed ocean liners, the increase in steam consumption per effective horsepower is about 9 per cent with turbines. On the other hand the turbine is much simpler to operate and adjust, and when well designed and constructed should run with very little fear of breakdown. A considerable saving in oil and attendance results from its use, and in all probability it will last much longer. These advantages must be set against the increase in the coal bill. Now, such an increase on the coal bill of a racing liner is naturally a very serious matter, and it is very doubtful whether any of the above advantages can compensate for it.

Balance in Favor of Reciprocating Engines.

It would seem, then, that, on the whole, the balance is in favor of the reciprocating engine even for mail steamers of the highest speeds. However, a slight increase in the efficiency of the turbine-driven propeller might suffice to turn the scale in favor of the turbine system. It must be remembered that improvements in reliability and efficiency are in the future, and it is the present we are concerned with. When we consider the case of ocean liners of rather slower speed, it is very evident that the turbine cannot be expected successfully to compete with the highly efficient combination of reciprocating engine and propeller fitted to this type of vessel. So that it seems probable that the piston engine will continue to hold its own for some time to come, as far as this class of work is concerned, although something may be done with the combination of the two systems.

A good deal has been written lately regarding the application of the turbine to slow-speed cargo tramps. A little reflection will show that it is

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out of the question to apply the turbines to the propeller shafting without the use of some form of intermediate gearing.

In the first place, in order to have the revolutions per minute such that the weight of machinery would remain unaltered, it would be necessary to adopt propellers with a pitch ratio of about 0.55. Now, the pitch ratio of most turbine-driven propellers is in the neighborhood of unity, and although they work behind fine lined ships, their efficiency is decidedly low. What, then, can be expected from propellers with a pitch ratio of 0.55 working behind the bluff stern of a cargo tramp with a 20 per cent wake? Something might be done by the adoption of some form of gearing, but the problem is capable of no easy solution. It is rather difficult to understand this anxiety to discard the well-tried piston engine for the steam turbine in this class of vessel, for the advantages to be gained by so doing are not at all evident. The reciprocating engines fitted to the ordinary cargo tramp are very economical in themselves, and are combined with the propellers which are best suited to this class of work. They are thoroughly understood and require and generally receive very little attention when under way. On the other hand, it is impossible to obtain a reasonable efficiency from the fine pitch ratio screws associated with the turbine system when workink behind such vessels, to name only one difficulty.

Propeller the Weak Point.

From the whole of the foregoing remarks and comparisons it is obvious that the propeller is the weak point in the turbine system, and that with the efficiencies obtained up to the present the turbine can only compete successfully with the least efficient classes of reciprocating marine engines. No doubt some improvement in this direction may be expected as a more accurate knowledge of the performance of turbine-driven propellers is obtained.

An important step in this direction would be the adoption of a practical form of thrust meter, and the direct measurement of thrust horsepower. However, at the best the improvement to be expected cannot be of great amount. Thus it would appear that the extent of the successful application of the marine steam turbine in its present form to merchant vessels is likely to remain considerably restricted.—*The Engineer.*

Scout Cruiser Trials

The navy department recently gave out a preliminary report covering the coal consumption tests of the scout cruisers Salem, Birmingham and Chester. The results tabulated are as follows:

Test No. 1. Duration of Trial, 96 Hours. 10 Knots Speed.

	Birmingham.	Chester.	Salem.
Feed water used per day	10.55	10.97	11.66
Coal used, tons per day	31.74	40.44	53.85

Test No. 2. Duration of Trial, 50 Hours. 15 Knots Speed.

Feed water used per day	13.9	13.2	12.12
Coal used; tons per day	71.23	85.62	107.23

Test No. 3. Duration of Test, 98 Hours. 20 Knots Speed.

Feed water used per day	26.1	16.8	17.51
Coal used, tons per day	153.47	157.15	202.03

Test No. 4. Duration of Test, 24 Hours. Maximum Speed.

(Due to an accident the Birmingham discontinued this test after 12 hours.)

Feed water used per day	120.4	27.0	45.625
Coal used, tons per day	375.72	416.7	415.7

Owing to the damage to the starboard turbine of the Salem, which was not known at the time of the test, the navy department does not consider the tests, as regards the Salem, accurate or conclusive, and they will be repeated.

No definite announcement has been made as to the nature of the accident to the Birmingham which occurred on her 24-hour maximum speed test. In the case of the Salem it was noted that the starboard turbine ran considerable slower than the port with the same steam supplied.

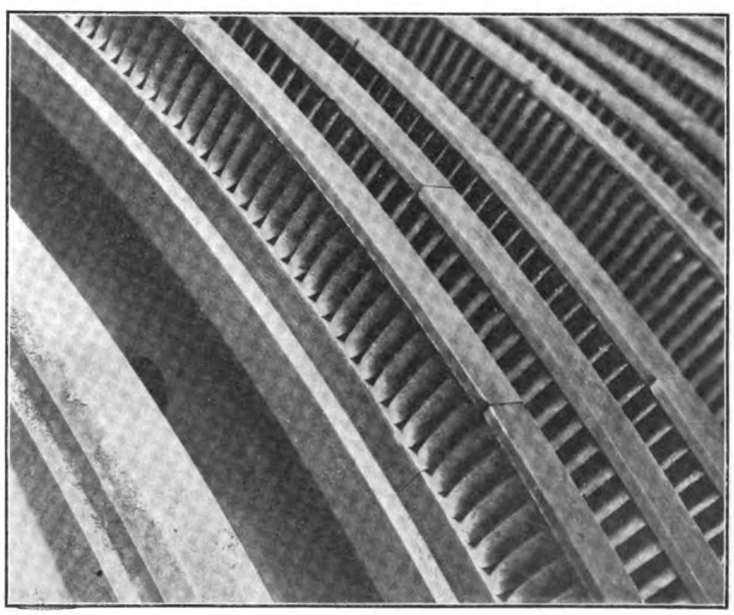
When opened up it was discovered that some foreign body had become caught in the fifth stage between the nozzles and first row of buckets. It had bent over the edges of the buckets so as to completely prevent any steam passing through them and had broken about one-quarter of the nozzle division plates. The foreign body which caused this has not yet been found, but a loose 5/8-in. nut was found in the fifth stage lying in the bottom of the casing and did not become caught in the moving parts.

Examination of the port turbine disclosed a service bolt 2½ in. long, which was not a part of the machine, lying in the first stage against the nozzle openings leading to the second stage. The damage done here was comparatively slight.

The rotors of both machines were also found to have moved axially so as to allow the moving buckets to rub against the stationary guide blades, with the result that in the first and second stages where the axial clearances are least, the guide blades were worn on the edges; but no blade stripping occurred. As in these stages the guide blades only cover a small part of the circumference, practically all the wear occurred on them and very little on the moving buckets.

All blading was found to be entirely free from any erosion due to the action of the steam, and the surfaces were as smooth as when first installed.

The Fore River Ship Building Co. makes no charge of vandalism regarding the damage, believing that the bolts may have been accidentally



DAMAGED BUCKETS OF THE CRUISER SALEM.

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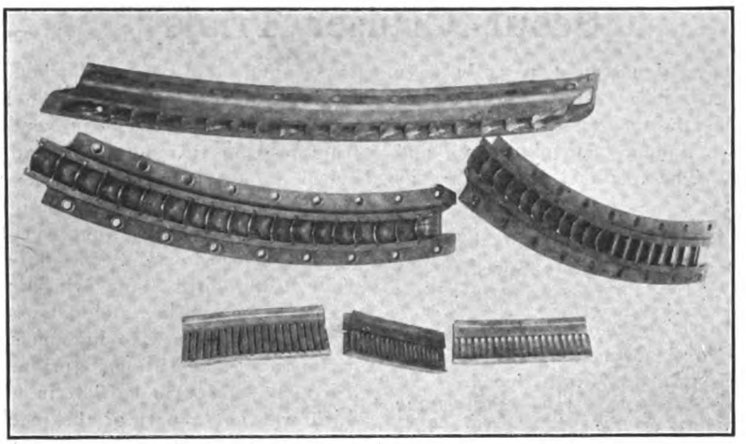


SECTIONS OF BLADING FROM TURBINES OF CRUISER SALEM SHOWING EDGES OF BUCKETS TURNED OVER.

dropped into the turbine during the installation.

The maximum speed of the Chester was 25.08 knots. The Salem 24.54 knots for 24 hours and for the first 8 hours made 25 knots. The speed of the Birmingham is not given out.

Repairs to the Salem were completed early in June and on June 10 she left for the Azores to join the Chester and Birmingham which had left previously.

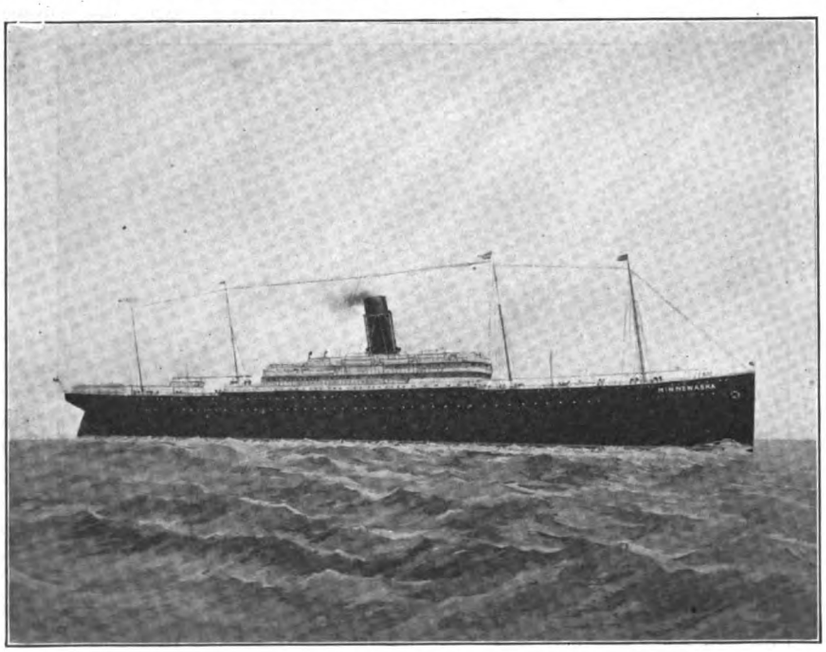
ATLANTIC TRANSPORT LINER MINNEWASKA.

The Atlantic Transport Line will this month place the new steamship Minnewaska in regular service between New York and London. The Minnewaska was built at the yards of Harland & Wolff, Belfast, and is a twin-screw vessel 615 ft. 3½ in. long by 65 ft. 3½ in. beam, with a gross tonnage of about 14,500. She is equipped with quadruple-expansion engines and made an average speed of 17 knots on her trials.

As is the case with the other vessels of the Atlantic Transport Line the Minnewaska will carry first class passengers exclusively. The staterooms are located on the bridge and shelter decks and are fitted with every modern convenience. They are exceptionally well situated for light and ventilation, the windows being of large size and superior pattern. The suites on the bridge deck are unusually fine rooms, having toilet rooms and lavatories attached.

The dining saloon is situated nearly amidships on the shelter deck, extends the full width of the vessel, and accommodates all of the passengers at one sitting. It is framed and paneled in oak relieved with pokerwork, the dado and furniture being also in oak. The lounge is situated on the boat deck, forward, the reading room on the boat deck amidships and the smoking room on the boat deck aft. There is the usual barber shop, surgery and other rooms, the accommodations throughout being very elaborate and comfortable.

The Minnewaska has eight steel decks, six of which are plated throughout. The double bottom extends the ful length of the vessel, while the hull is divided into eleven water-tight compartments. Submarine signaling apparatus is installed, as is also the latest arrangement of wireless telegraphy. There are accommodations for 326 first-class passengers.



ATLANTIC TRANSPORT LINER MINNEWASKA.

THE NEW WHITE STAR LINERS.

The progress being made with the construction of the gigantic liners Olympic and Titanic, at Belfast, is now becoming more evident. The work on the Olympic is the further advanced, the slip on which she is laid down having been the first ready for the builders. The framing of the cellular double bottom is already complete, and the bottom shell plates and tank intercostals are being fitted and hydraulic riveted. The tank top plating is also being proceeded with. A notable feature in the construction of these vessels is that the whole of the shell plates to the upper turn of bilge will be riveted by hydraulic power.

The work at the Titanic on the adjoining slip is also making interesting progress, the hydraulic riveting of the keel center plate (or vertical keel) nearing completion, and the erection of the floors in the double bottom having been commenced. The gantries and hydraulic riveters suspended from the traveling frames perform a very important part in the work of construction; each riveter (weighing over seven tons) can be moved to any desired position over the entire length of the structure with the greatest facility. Amongst other interesting appliances on the building berths are the portable oil furnaces for heating the rivets. The liquid fuel is sprayed into the furnace by compressed air, great heat being generated in a very short time and well distributed over the furnace. These oil furnaces are a great improvement on the old type—in fact, everything that ingenuity can devise has been called into requisition in their construction. It is claimed that the strength of the structures will greatly exceed anything at present afloat.

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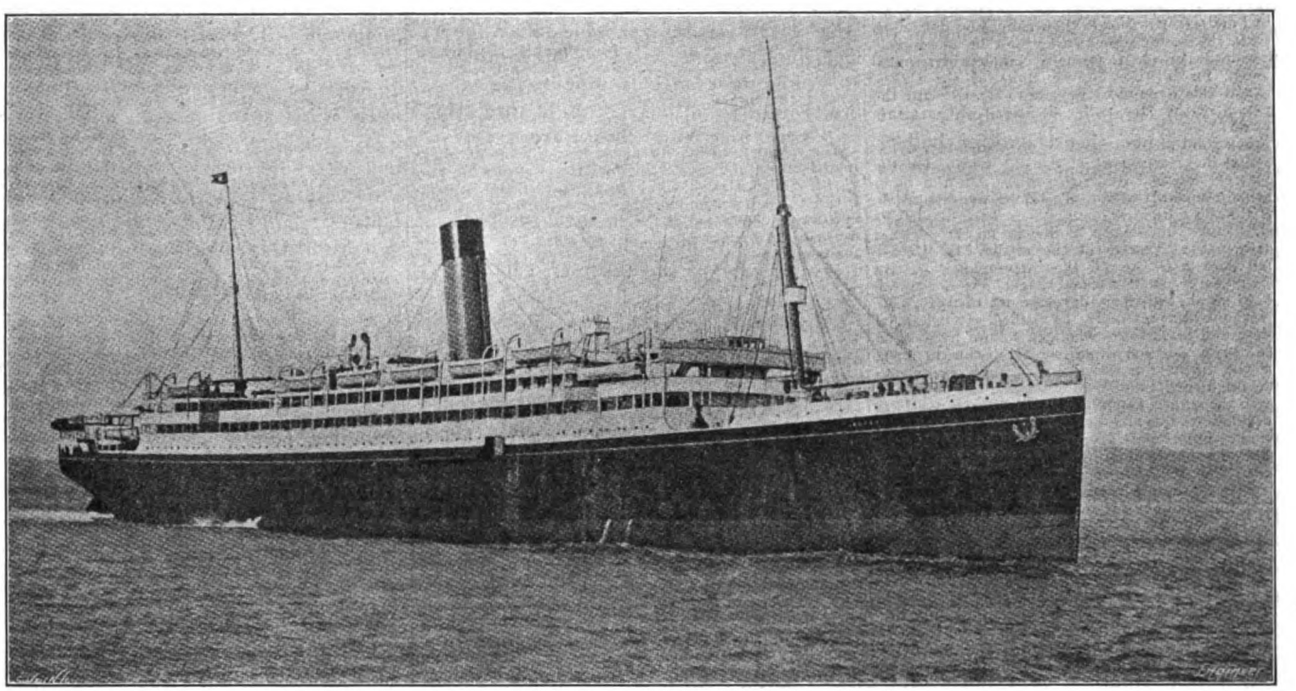
Combination of Reciprocating and Turbine Marine Machinery

THE new White Star liner Laurentic, which left on her first voyage to Canada during the latter part of April, is of special interest as the first Atlantic liner fitted with a combination of reciprocating and turbine machinery. She is notable also from other points of view: she inaugurates the White Star service to the Dominion, and, in view of the great potentialities of our western colony, and of the repute of the White Star company, there can be no question as to the advantage and success of this additional Empire line. The Laurentic too, is larger than any other ship in the Canadian service; her length is 565 ft. 6 in. over all; beam, 67 ft. 3 in.; and depth, moulded, 45 ft. 6 in.; the registered tonnage being about 15,000 tons, and the displacement at service draught about 20,000 tons. Everything has been done to insure the safety and comfort of the 260 first class, 430 second, and 1,000 third class passengers to be carried; the decorations are in good taste, the wood, mostly oak, being finished in its natural color, and special care has been exercised in the selection of fine-grained panels and pilasters. The state rooms are in white enamel; and one feature in these, as in the public rooms, is the adequacy of ventilation by electrically-driven fans.

But, from the scientific point of view, interest centers in the machinery. The White Star Line has ever been noted for its enterprise, and has found in Messrs. Harland and Wolff, of Belfast, able and willing coadjutors in the introduction of improvements and invention. It is not necessary now to recall the great departures in marine construction which were originated by the late Sir Edward Harland and the late Mr. T. H. Ismay in the early and succeeding White Star liners, and it is gratifying to have the further evidence afforded by the Laurentic of the maintenance of traditional progress by their successors, Lord Pirrie and Mr. J. Bruce Ismay. The Laurentic has, as sister ship, the Megantic, differing only in the machinery, and thus there will soon be available accurate comparative data of the performances of the two different types of machinery. As is well known, the idea of the combination is to utilize in the turbine the remaining heat energy in the exhaust steam from reciprocating engines, which, as a rule, is not less than 10 lb. pressure absolute. With the Parsons steam turbine it is possible to expand this low-pressure steam to a low absolute pressure corresponding to the highest vacuum obtainable in turbine practice. While it is too early to speak with confidence as to the measure of economy obtainable under service conditions in the Laurentic, the full-power trials, although short in duration, gave results which confirm those achieved in two other vessels having the same combination of machinery—the New Zealand liner Otaki, built by Messrs. Denny, of Dumbarton, and the yacht Emerald, engined by the Parsons company. The water consumption for the main engines was appreciably under 13 lbs. per horsepower per hour, while in Atlantic liners with triple-expansion engines the rate is rarely under 16 lbs. With a rate of evaporation in the boilers of 8 lbs. per pound of Welsh coal, or slightly less with the more largely used Yorkshire coal, the financial gain is considerable, for not only is the coal bill reduced, but the increase in cargo capacity due to smaller boilers and bunkers, is also a consideration in the balance sheet. It is true that the weight of engines and space occupied are greater when the turbine supplements reciprocating engines; but the reduction in steam consumption justifies less boiler power, and thus on a balance the weight may be about the same. Moreover, the system is specially applicable to vessels of less than 18 knots speed, in which neither weight



THE WHITE STAR CANADIAN LINER LAURENTIC.

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nor space is of such importance as in high-speed ships. The question is primarily one of economy.

Description of Machinery.

We are indebted to Mr. Ismay for special permission to inspect the machinery of the Laurentic; the result of our observations must be pronounced in terms complimentary to the designers. As to the boilers, there are in both the Megantic and the Laurentic six double-ended steam-generators for a working pressure of 215 lbs. The proportions of the boilers are the same in each ship, the allowance in heating surface being, in accordance with the White Star practice, about 2½ sq. ft. per horsepower, while the ratio of heating surface to grate area is 37 or 38 to 1. With the higher steam efficiency of the combination system of machinery, a reduction on these proportions will be justified, and it is probable that with experience the design of boilers will be so modified as to compensate for any increase in weight in the engine room. In making the experiment with these two Canadian liners the builders and owners have acted with their characteristic prudence, as the experience gained will enable them to so proportion the machinery in the two immense White Star liners now being built at Belfast as to insure the best results. These vessels are to be of about 45,000 tons gross register, with machinery of nearly 50,000 horsepower to give a speed of 21 knots, so that the application of machinery of the combination type may result in a considerable total saving in consumption.

The machinery of the Megantic, the twin screw ship, is of a quadruple-expansion type, the cylinders being 29 in., 41½ in., 61 in., and 87 in. in diameter respectively, with a stroke of 60 in.—proportions which will give a very satisfactory range of expansion. In the Laurentic the reciprocating engines are of the triple-expansion type, with four cylinders to insure perfect balancing. The cylinders in this case are 30 in., 46 in., 53 in. and 53 in. in diameter respectively, with a stroke of 54 in. The general design follows Messrs. Harland and Wolff's practice, with single columns, which give an open engine. In the Megantic, however, the condensers form part of the framing, and the air and circulating pumps are placed contiguous to the condenser. In the Laurentic the condensers are of necessity independent. In this latter ship the engines are at a greater distance apart than in the Megantic, to suit the three-propeller arrangements. The low-pressure turbine of Parsons' latest turbine type is in the center of the ship, and abaft the main engines, with one condenser on each side, while the auxiliary machinery is arranged in the wings. We understand that the principal difference in the disposition of the machinery in the two ships is that in the Megantic the electric generators—three sets of Allen's machines, of 750 amperes at 100 volts—are placed where the turbine is accommodated in the Laurentic, while in the latter ship the electric generators take the place of a small coal bunker at the forward end on the port side of the engine room. The center shaft also encroaches on the cargo space available abaft the machinery-room in the Megantic.

Confining ourselves now to the result of observations on the Laurentic, we may note that the exhaust pipes from the two low-pressure cylinders, which are at the extreme ends of each engine, are led, with the usual expansion, or bellows, joint, to the forward end of the turbine. On each pipe there is a double-beat valve, operated each by a separate high-pressure engine secured to the after bulkhead in the engine room, and controlled by levers at the reciprocating engine starting platforms. These engines and valves can be worked independently, but are normally connected, and work simultaneously. The turbine will be thrown out of action for all maneuvering: in other words, when the telegraph indicates "stand by." The double-beat valve will then pass steam to the condenser, and the ship will maneuver as a twin-screw steamer. The benefit in having independent valves is, that should one of the engines break down, two propellers will be available for driving the ship, one rotated by the reciprocating engine in service and the other by the turbine. There is thus the advantage that with one engine out of use two-thirds of the total power would be available instead of one-half, as in an ordinary twin-screw ship, so that the reduction in speed would be considerably less.

The trial trip results showed the possibility of this maintenance of high power with one engine out of service, as the low-pressure turbine developed 4,600 shaft horsepower out of a total of 12,400 horsepower, the exhaust pressure from the reciprocating engine, and therefore the initial pressure in the turbine, being about 18 lbs. absolute. The speed obtained exceeded the 16 knots anticipated by the design. The main engines were designed to run under these conditions at about 83 revolutions while the turbine made 220 revolutions.

The turbine, as we have already indicated, accorded with Parsons' latest practice, and gives 28 shaft horsepower per ton. The thrust-bearing is at the forward end, with the forward main bearings betwen this thrust and the rotor, and the after bearing abaft the rotor. The blading is arranged for six expansions, the lengths being from 6 in. to about 10 in., while the average clearance is about one-tenth of an inch. There is the usual arrangement for adjustments, and the bearings are lubricated by gravity with two stand-by oil pumps. The shaft-bearings have also water circulating round them. In order to obviate any matter passing over with the steam to the turbines, strainers have been fitted in the steam pipe between the reciprocating engines and turbine; provision is made for lowering these strainers for examination and cleansing.

Auxiliaries.

As to the auxiliary machinery aboard the ship, it is of a most comprehensive type. Weir's independent air-pump and Harland & Wolff's circulating pumps are fitted for each condenser, and Weir's monotype air pump and Harland and Wolff's centrifugal pump for the auxiliary condenser, with the usual hot-well pumps, filters, feed-heaters and feed pumps. The hot water for the baths is got from the condenser, and, like the fresh water, is pumped to supply tanks on the boat deck to gravitate to all parts of the ship. The bilge, sanitary, and other pumps are all of high capacity, and, with the main feed and hot-well pumps, are accommodated in the engine room. Reserve pumps, however, are placed in a forward compartment so as to be available for their duty should the main engine room be flooded. Here are also Hall's CO_2 refrigerating installations for the holds and for eight independent rooms for storing ship's provisions, the latter being exceptionally extensive. The refrigerating pipes, ballast pipes, winch steam leads, and other such communications are in a tunnel over the ballast-tanks, so that they are always open for examination, and do not obstruct the alley-ways or decks for passengers. With other features of the ship we shall, we hope, be able to deal later,

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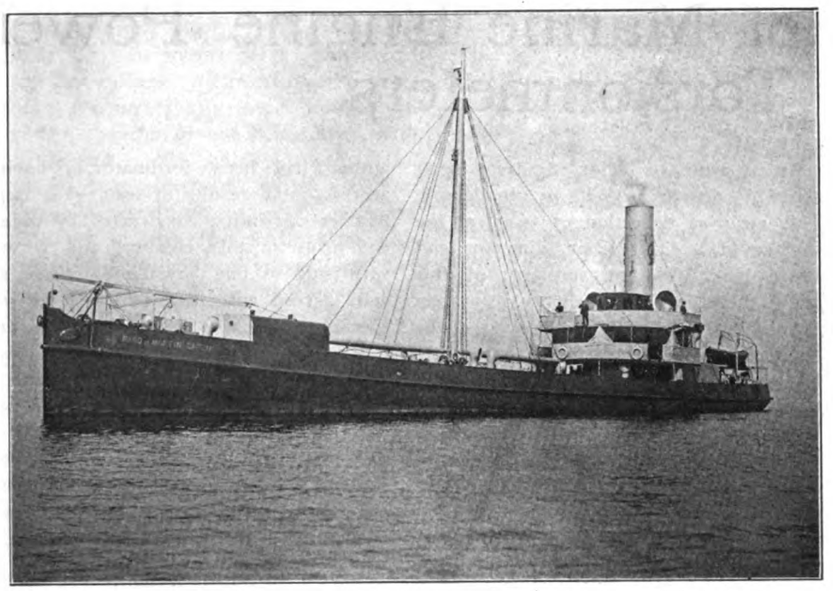
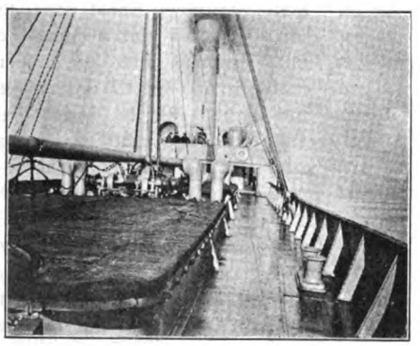
when further information is available as to the ocean performance of this interesting vessel and her consort.—*Engineering.*

THE THORNYCROFT SHALLOW DRAUGHT STEAMERS FOR THE AMAZON.

With the delivery of the steamer Paso de San Lorenzo, which sailed from their Southampton works recently, Messrs. John I. Thornycroft & Co., Ltd., completed their contract for the supply of five vessels of somewhat unique features for the Amazon trade. The vessels in question are destined to open up the interior of Argentina—particularly the rich region through which flow the Parana, Uraguay and Paraguay rivers. The resources of this country have been but feebly tapped hitherto, and it is the culmination of the general desire of influential Argentinas, that the benefits should be reaped by their own country, which has seen the formation of the company, Marina Mercante Argentina, for whom the vessels have been built.



THORNYCROFT SHALLOW DRAUGHT STEAMER FOR THE AMAZON.



SHALLOW DRAUGHT STEAMER FOR THE AMAZON.

The five steamers particularly exemplify the class of work in which Messrs. Thornycroft specialize, i. e., large carrying capacity on small draught. A load of no less than 730 tons is provided for on a draught of only 8 ft.

The dimensions are 220 ft. in length by 33 ft. breadth, with a displacement of about 1,200 tons. The machinery comprises two sets of inverted triple-expansion surface condensing Thornycroft type engines, steam being supplied by two marine type return-tube boilers.

A speed of 10 knots, mean, is guaranteed, but this was exceeded very considerably on the official trials. The first boat actually ran at 11¼ knots as a mean of six runs on the admiralty course at Stokes bay, carrying the full load of 730 tons.

The hull is built throughout of Siemens-Martin steel, and the vessels are classed 100 A.1 at Lloyds.

Several powerful winches are installed on each ship, to facilitate handling the cargo, which, being timber principally, has had to be provided for by specially large cargo hatches.

Electric lighting is provided throughout, and the other arrangements are such that the boats are particularly adapted for working in the very hot climates to be met with in the northern portions of the rivers.

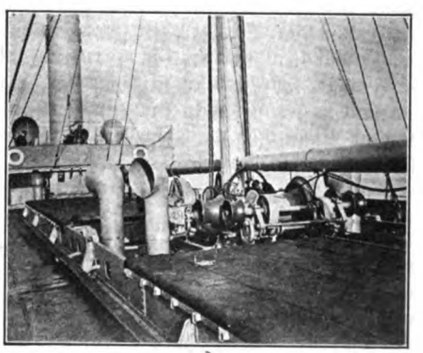
The first few vessels have steamed out to Buenos Ayres without incident, though an exceedingly rough passage was made by the Paso de Obligato, from Southampton to St. Vincent. Nevertheless the whole journey occupied 34 days, the coal consumed being 40 tons less than was anticipated, and working out at the very economical figure of 1.87 lbs. per I. H. P. The subsequent vessels, with more favorable weather, have reduced the time for the journey by several days.

Some very roomy saloons on deck have been added to the last two or three vessels, greatly improving the passenger accommodations (which was not originally specified) and incidentally, the appearance of the vessels.

The whole of the work was carried out by Messrs. Thornycroft.

SUCTION PLANT FOR MARINE WORK.

A visit was recently paid by the Institute of Marine Engineers to the works of Messrs. Capel & Co., Dalston lane, London. The visit was arranged principally in view of a paper on the question of the adaptability of the gas engine and suction plant for marine work, recently read before the members by Mr. E. Shackleton, which has aroused a good deal of interest, Messrs. Capel & Co. more particularly devoting their attention to the production of this type of engine. The erecting shop was first visited, under the guidance of Mr. F. Sellers, and here were seen gas engines in various stages of construction. Particular attention was given to a 65 H. P. suction gas engine, the various parts of which were minutely examined, the very large water-cooling space for the combustion chamber being noted, also the arrangement of the liner to eliminate the joint between the combustion chamber and the water space so often the cause of trouble in gas engines, and other details.



SHALLOW DRAUGHT STEAMER FOR THE AMAZON.

The party afterwards visited the testing shop, where a 40 H. P. suction

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gas engine was running, working on the Otto cycle. The suction gas generating plant, practically a large American stove, the gas from which is utilized instead of passing up the chimney, was then examined, and its construction explained by Mr. Sellers. The distinctive feature of this plant is the patent exhaust evaporator, the arrangement consisting of an exhaust silencer fitted with an internal non-pressure evaporator, in which steam is raised by the waste heat from the exhaust. The plant is also fitted with a hot gas evaporator and air heater, which consists of a water jacket round the gas pipe, immediately above the generator, so that the water and air are heated, and steam is formed by the heat of the gas. By means of these two evaporators, therefore, practically all the waste heat is utilized. Anthracite coal is used, and in the case of the 25 B. H. P. producer in use at the works, it was stated that the cost averaged 1s per day in fuel for the ordinary working day. It is claimed that the usual cost of the suction gas producer is one-tenth of a penny per H. P. per hour.

Measurement of Marine Engine Power by Torsionmeters

AT A MEETING of the Greenock Association of Engineers and Ship Builders, held in Greenock recently, a paper on "The Measurement of Power by Means of Torsionmeters," was read by Joseph Menmuir, A. M. Inst. E. E., of the staff of Messrs. Kelvin and James White, Ltd., Glasgow. After referring to the introduction and development of the steam turbine and to the inability of engineers to measure, by means of the steam indicator, the power developed in them, as in the case of ordinary reciprocating engines, the author outlined the steps which have led to the invention of various forms of torsionmeters for the purpose. Having explained the angle of twist, or "torsion," of a shaft rotating and transmitting power, and that this varied directly as the moment of power applied and the length of shaft over which the measurement was made, and inversely as the modulus of rigidity of the shaft and the diameter of the shaft to the fourth power, the author said that the torsionmeter provided a means of measuring the angular deflection on a length of shaft while rotating and transmitting power, and from this the value of the power could be easily calculated.

Let—

θ = Angle of deflection.
N = Number of revolutions per minute.
L = Length of shaft in feet.
M = Modulus of rigidity.
D = Diameter of shaft in inches.

Then H. P. $= \frac{\theta D^4 N}{M L}$.

The law embodied in the above formula was found to hold good for all shafts which were not stressed beyond the elastic limit. The angle through which a shaft was deflected at normal full load was very small, the actual value at ordinary factor of safety being about 1 degree per 10 ft. in length. This meant a deflection of ⅛-in. at the surface of a shaft 12 in. diameter and 10 ft. long. The measurement of this angle, therefore, must be very accurately carried out if reliable results were to be obtained. The error of a hairsbreadth, in fact, might mean several thousand horsepower.

Marine Shafting.

Referring to marine shafting particularly, the author proceeded to say that in order to secure the best possible results the shafts should be calibrated before being put in position in the vessel. "This is done by bolting up the couplings of the desired length of shaft and suitably supporting same. The one end is fixed rigidly, and to the other end a lever is attached, to the outer end of which various weights can be applied. Another method is by using two levers at opposite sides of the shaft, one being pulled downwards and the other upwards by means of spring balances. This gives a more equal turning moment and reduces the chance of error due to friction at the point of support. Two pointers are attached to the shaft, one close to each end, and these move over graduated scales. If the pointers are made 57.3 in. long from center of shaft the reading will be exactly 1 degree per inch of deflection. The shaft is now subjected to a known twisting moment by means of the weights or spring balances and the deflections of the two points noted. The difference between the readings will give the true deflection on the part of shaft between the pointers. With reference to couplings which may intervene within the test length it is found sufficiently accurate in practice to deduct the axial length of these entirely. The net rated length of shaft will therefore be equal to the length between the two pointers, less the sum of the couplings which intervene." The author had been fortunate in having access to the results of tests of a large number of shafts, constructed by different firms in this country, and it was surprising to find how closely these results agreed with each other. This was specially the case for solid shafts, and the mean value got from these tests could be accepted as correct within a very small percentage. Indeed, the actual calibration of many shafts could be dispensed with entirely. For hollow shafts the results were not so consistent, but where extreme accuracy was not required the torsional rigidity of a hollow shaft could be taken as equal to that of a solid shaft of the same external diameter, minus that of a solid shaft of the same diameter as the bore of the hollow shaft.

Compression Stresses

In addition to being subjected to a twisting moment propeller shafts were at the same time subject to a compressing stress equal to the thrust transmitted from the propeller to the thrust block. Some engineers held that the thrust did not affect the accuracy of the torsional readings, and one eminent marine engineer on the Clyde had informed the author that he had looked very carfully into the matter and was convinced that it only affected the torsional readings to the extent that the shaft was made shorter under compression. In opposition to this view, however, Mr. J. J. Hamilton Gibson in a paper read before the North East Coast Institution of Engineers and Shipbuilders in January, 1908, stated that compression augmented the torsional deflection about 1 per cent for solid shafts, and as much as 3 per cent in the case of hollow shafts at full power, and he recommended that while the shaft was under static calibration it ought also to be subjected to a compression stress such as it would sustain under working conditions.

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Divided Into Groups.

The author divided the various types of torsionmeters at present in use into three groups: (1) mechanical; (2) flashlight; (3) electrical; and proceeded to give brief descriptions of most of them, devoting attention chiefly to one type in the latter class with which he had had considerable experience. In Class I. the mechanism of the torsionmeter invented by Mr. Collie consisted of two countershafts mounted parallel to the shafts under test. The remote ends of each were driven from the main shaft by means of the chains and sprocket wheels. The two free ends of the countershafts were brought together, the end of one being fitted with a screw of quick pitch and the other provided with a sliding sleeve carrying a nut engaging with the screw. The shafts were provided with collars to prevent endwise movement. It will be understood that if the one end of the main shaft were twisted through a certain angle one countershaft would revolve in advance of the other, and this would cause a movement of the sleeve due to the action of the screw and nut. The movement of the sleeve was made to actuate a pointer moving over a graduated scale, from which the power could be calculated. It could also be arranged to give a continuous record by means of a pencil on a moving band of paper. Another type of mechanical torsionmeter was that invented by Dr. Fottinger, of Berlin, which consisted of two tubes which surrounded the shaft, the outward ends being connected rigidly to the shaft, while the free ends were brought together and each fitted with a flange. "If the diameter of these flanges is 24 in., and the distance between the fixed outer ends of the tubes is 10 ft., there will be a deflection of ¼ in. at the rim of the flanges at full load. Multiplying levers are used and actuate a pencil which makes a record on a paper cylinder fitted concentrically with the shaft. In the case of a turbine this record will be practically a straight line, but in that of a reciprocating engine the record will show the combined crank effort diagram throughout the entire revolution, and by this means very valuable data can be obtained, which unfortunately is quite beyond the scope of an ordinary indicator diagram. It is claimed for this torsionmeter that all backlash of levers and gear is taken up by means of springs, and the readings got are quite accurate."

Flashlight Types.

Of the flashlight type of torsionmeter, the first example referred to was that by Amsler, the inventor of the well known planimeter bearing his name. This apparatus was similar to Fottinger's, in that two tubes were used arranged concentrically with the shaft, the discs on the free ends being brought close together. An index line was engraved on the one, and a graduated scale on the other. Electrical contacts were arranged on the shaft in such a way as to cause an electric spark to pass at the instant the graduated scale was passing. Under these circumstances the scale appeared absolutely at rest, and a reading of the deflections over the test length of shaft could be obtained. Another form of torsionmeter in which concentric tubes were used had been brought out by Prof. Hopkinson. Instead of a scale, the discs on the ends of the tubes were used to actuate a small pivoted mirror, a lamp and scale being so arranged that a beam of light from the lamp was reflected by the mirror on to a scale. If the shaft was rotating at 300 R. P. M., or over, the reflected beam would appear practically continuous, and the deflections could be read with a good degree of accuracy.

The Bevis-Gibson Type.

Perhaps the most successful torsionmeter of the flashlight type was that known as the Bevis-Gibson, in which two discs were attached to the shaft—one at each end of the test length—in each of which there was a narrow radial slot. Behind the one disc a lamp was fitted in a closed chamber having a narrow slot facing that in the disc, and behind the other disc, at the same radial distance from the shaft, was placed the "torque finder", which consisted of an eye-piece fitted with another similar narrow slot and mounted in a carriage having a micrometer screw adjustment. When no power was being transmitted by the shaft, the four slots were all in line and the beam of light passed freely through and was seen at the eye-piece of the torque finder, this forming the zero reading of the micrometer. Immediately the shaft began to transmit power the after disc lagged behind the forward one, and the torque finder required to be moved through a certain angle until the light could be again seen. In the case of reciprocating engines the discs were pierced by 12 equidistant slots, so that the deflections at 12 points in the revolutions could be ascertained, and the mean power calculated. An objection has been raised to this type of torsionmeter that unless the slots were infinitely fine there were doubts as to the exact readings. Mr. Gibson, however, claimed that by taking the reading in each case just at the point when the illumination of the beam entirely disappeared the readings could be got with great accuracy. Another point of possible error was that if the air between the two discs was not entirely homogeneous and constant, the beam of light might be refracted through a greater or less angle, and thus vitiate the results. In this, as in all the foregoing types of apparatus, it was, as a rule, necessary to carry out the actual tests in the shaft tunnel, and those acquainted with the cramped limits, inconvenience, and general conditions obtaining in that quarter, during a trial trip especially, would be best able to judge of the satisfactoriness or otherwise of the readings.

Electrical Type of Torsionmeter.

In the electrical type of torsionmeter the actual measuring apparatus could be placed in a quiet, cleanly cabin, far removed from the shaft tunnel or engine room with their attendant noise, heat and smell. Two very similar types had been brought out by Messrs. Barr and Stroud, of Glasgow, and by Mr. Gardiner, of Fleetwood, for both of which the same general description would suffice. The arrangement consisted of two metallic wheels or discs, say, 3 ft. diameter, attached to the shaft at the desired distance apart. Each wheel had a large number of slots cut in the periphery, the width of slots being exactly equal to the distance between them. The slots were filled with insulating material and the whole turned up true and smooth, somewhat resembling, when finished, a dynamo commutator. Conducting brushes were made to bear on the rim of each wheel in such a way that when not transmitting power the brush on the one wheel left the insulated slot at the same instant that the brush on the other wheel left the metal between the slots. The electrical connections were arranged as follows: A battery as a source of current, and an amperemeter, were connected up between the two brushes, the circuit being from the battery, through the amperemeter to one brush, through the metal of wheel and shaft to the other wheel, and thence to the second brush and back to the battery. "Under the conditions just mentioned, when one brush just leaves the conducting metal when the other leaves the insulating material, there will never be a closed circuit. When, however, the one wheel lags behind the other, due to torsion, the brush on the one wheel will not have left the metal portion until the brush of the other wheel is also bearing on the metal portion. The result will be a momentary current which will give the amperemeter a kick, and as these kicks occur many times during one revolution the result will be a contin-

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uous deflection, and it will be seen that the amount of deflection will depend on the time the two brushes are simultaneously on the metallic part of the wheels. This in turn will be proportional to the deflection of the shaft between the wheels, and hence to the power transmitted." The amperemeter could be graduated, if desired, to read directly in horsepower for a given diameter of shaft, number of revolutions, and distance between the wheels. The author has not been able to get any data as to the practical performance of this apparatus, but the idea to him looked attractive.

Invention of Archibald Denny.

The type of torsionmeter with which the author has had a good deal of experience, as already stated, was that invented by Mr. Archibald Denny, of Messrs. Denny and Brothers, Dumbarton, and Mr. Charles Johnson, a member of their staff. The apparatus consisted of two wheels of non-magnetic material, usually gun-metal, fixed to the shaft at each end of the test length, each wheel being provided with a radial slot in which a chisel-pointed permanent magnet was fitted, the tip of magnet projecting about ¼ in. beyond the rim of wheel. Fitted in a convenient position, adjacent to the rim of each wheel, was an inductor consisting of a soft iron core, wound on which were one or more coils of fine, insulated wire. The face of the inductor was curved to the same radius as the point of magnet, and was fixed at a distance of 1-16 in. from same. The magnet in passing these coils once per revolution generated an electric current in them by electro-magnetic induction. The coils in each inductor were connected by means of a multicore cable to a recorder box, in which suitable contact keys were provided, enabling the operator to make contact with any individual coil on inductor. The currents from these coils were led by means of the keys already mentioned to a differential telephone receiver. When the currents did not reach the telephone at the same instant a ticking sound was heard. The keys were then moved till no sound was heard, which indicated that the currents reached the telephone at the same instant of time, or were "in phase". The sum of the readings on the keys connected to the two indicators gave the total deflection in inches, and from the simple empirical formula derived from that already given the horsepower could be obtained:

Let—

N = Number of revolutions per minute.
L = Length of shaft.
1.53 = A constant obtained from the modulus of rigidity.
D = Diameter of shaft.
R = Torsionmeter reading.
C = Inductor constant.

Then $H.P. = \frac{1.53\ R\ D^4\ N}{C\ L}$.

Proceeding to treat of the subject of power measurement by torsionmeters generally on board ship, the author stated that when using any form of torsionmeter it was advisable to check the zero reading when actually under way. He had known of cases where the alignment of the zero was perfectly correct when the shaft was at rest, but, through the turning gear having been left on, and there being a considerable amount of friction in the stern tube, the shaft, although at rest, was left in a state of twist. This was shown very clearly, when the turning gear was put in operation, by the shaft revolving in the stern tube with a series of jerks. The testing of zero readings could be easily carried out when under way in a twin or triple screw vessel by shutting off the steam from one shaft at a time, and allowing the propeller to be rotated by the action of the water. The shaft would then only be transmitting the power necessary to drive the turbine when empty, which was practically negligible. The readings could then be taken and compared with those taken when the shaft was at rest. These readings should preferably be taken both before and after the actual trials.

Advantage Over Steam Indicators.

One advantage of torsionmeters over steam indicators was that they could be left in position permanently, and readings taken at any time, on practically a moment's notice. This was particularly true of the electrical type by which the actual measurement was taken at a station remote from the shaft tunnel. From the ratio of the power developed to the knots logged the observer was able to compare the combined efficiency of the combination, and also judge as to the effect of the ship's bottom when clean or foul. One very interesting point was brought out on the trials of a steamer some time ago. This vessel was fitted with four shafts, all turning inwards. The propellers on the inner shafts were in the usual position for quadruple screws, the propellers on the wing shafts being a considerable distance forward of the inner screws. When steaming at full power, with throttle valves full open, the inner pair of shafts was found to be developing the greatest power. This, on the face of it, was hardly what might have been expected, considering that the outer propellers were working in what was usually spoken of as solid water, while the inner screws were encountering water already broken up by the propellers in front. The center shafts rotating as they did towards each other, and being closer together, seemed to act in such a way as to develop most power. In more recent ships, the author believed, the shafts had all been arranged to turn outwards, and a very equal distribution of power among the whole four shafts had been secured. In connection with the wing shafts an interesting point had arisen, and been studied, which was concerned with the action of the propeller blades when passing, in the course of their revolutions, close to the ship's side. It had been thought that the varying distance of the three blades throughout one revolution—or through one-third of a revolution—would cause an inconstant rate of work on account of the water being thrown against the ship's side more at one point of the revolution than at another. One firm of Clyde builders had carried out tests with this in view, and taken readings of the twist at points 30 degrees apart, throughout one-third of a revolution, and they found no appreciable difference between them. This seemed conclusively to prove that the action of propeller blades could be neglected, and that the twist could be properly read at any point throughout the revolution.

After brief reference to the uses of torsionmeters in connection with engines other than those for marine propulsion, the author, in closing, expressed the hope that his remarks had been sufficiently clear to show the great accuracy and adaptability of this method of measuring power. The ease with which it could be carried out, and the simplicity of the calculations required, all combined to render the torsionmeter an ideal means for the measurement of power, and there seemed no doubt of its extensive use in the future.

In his annual report to the New York state legislature F. C. Stevens, state superintendent of public works, recommends such improvement of the outlets of both Cayuga and Seneca lakes as shall make these lakes a part of the new barge canal system when it shall have been completed. From such data as he had at his disposal Supt. Stevens estimated that the deepening of the Seneca river, the Cayuga lake outlet, from the point where the barge canal enters the Clyde river, to deep water in Cayuga lake, can be accomplished for about $1,750,000 and that the deepening of the Seneca river from where it joins the waters of Cayuga lake to Geneva, will cost about $4,000,000.

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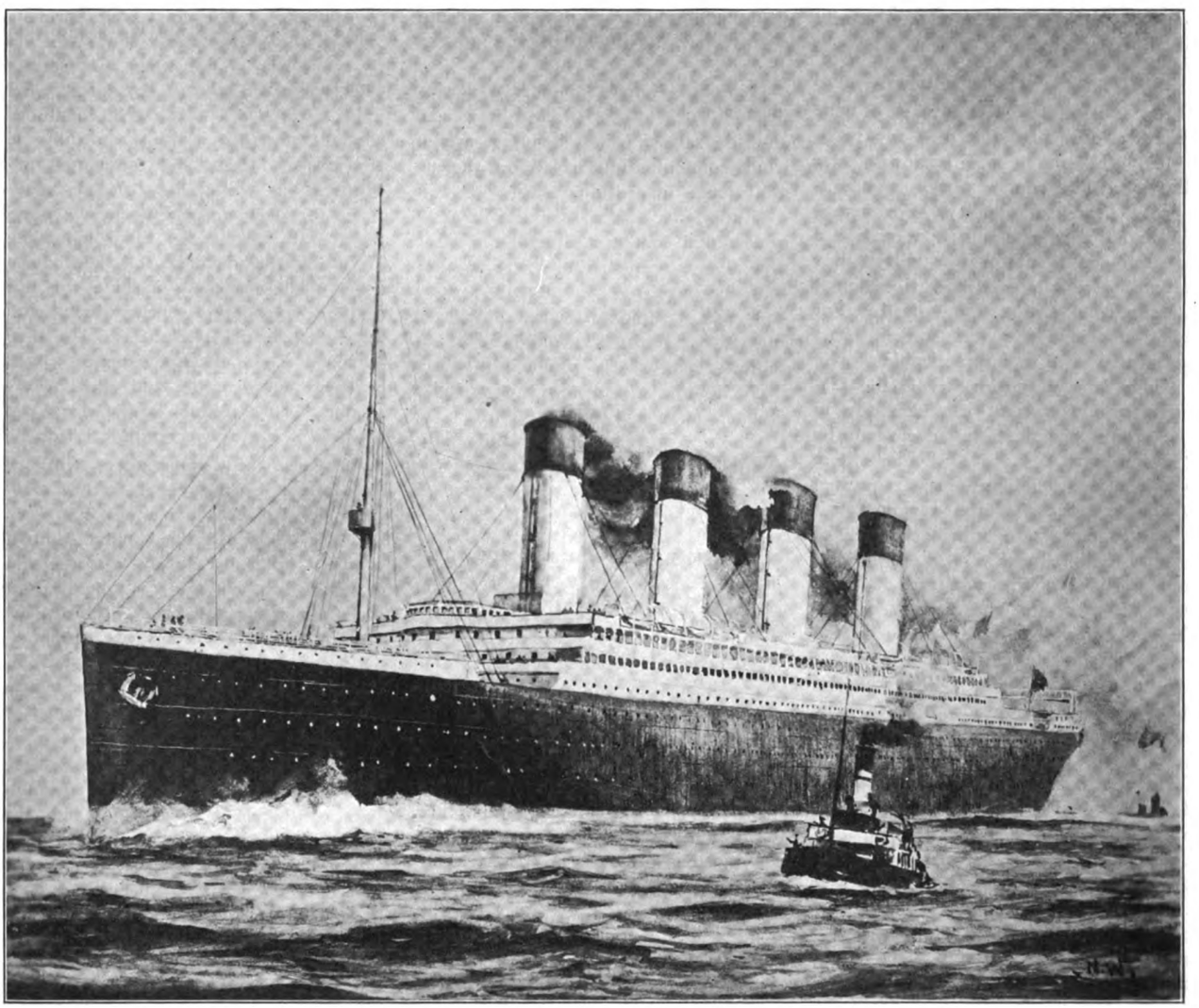

WHITE STAR LINERS OLYMPIC AND TITANIC AS THEY WILL LOOK WHEN COMPLETED.

Purchase of Coal on Its Heating Value

Washington, D. C., June 8.—The plan inaugurated two years ago by the government for the purchase of coal on its heating value has resulted in the delivery of a better grade of fuel without a corresponding increase in cost and with therefore a saving to the government. At the present time, 40 departmental buildings in Washington, the Panama railroad, more than 300 public buildings, throughout the United States, navy yards, and arsenals are buying their fuel supplies on specifications the prime element in which fixes the amount of ash and moisture.

Premiums are paid for any decrease of ash below 2 per cent from the standard at a rate of 0.01c per ton for each per cent. Deductions are made at an increasing rate for each per cent of ash when it exceeds the standard established by 2 per cent.

It has been demonstrated by the United States Geological Survey, Technologic branch, which has charge of the analyses of the coal, that under these specifications the government has been getting more nearly what it pays for, and paying for what it gets.

The purchase of coal on specifications is but one of the activities of the government looking toward a more efficient use of the fuel resources of the country. Engineers of the geological survey are studying the problem in all its phases at the experiment plant, in Pittsburg, Pa. The investigations, by suggesting changes in furnace equipment and in methods of firing the coal, are indicating the practicability of the government purchasing cheaper fuels, such as bituminous coal and the smaller szes of pea, buckwheat, etc., instead of the more expensive sizes of anthracite, with a corresponding saving in price. The fuel bill of the government now aggregates about $10,000,000 yearly, the saving on which, through securing coal containing less ash, alone amounts to $200,000.

Since the government has been purchasing coal on the basis of its heating value a growing interest has been manifest on the part of manufacturers and the general public in this important subject and a demand has been created for authentic information concerning the results accomplished. In response to this demand the results of the government's purchases of coal under the heat value specifications for the fiscal year 1907-8 have been assembled in a bulletin just issued by the survey in the hope of promoting a better understanding of this method of buying fuel. John Shober Burrows, the engineer in charge of this part of the fuel problem, has included in the bulletin a list of the contracts with abstracts

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of the specifications for the current fiscal year.

Nature of Specifications.

In explaining the nature of the specifications, Mr. Burrows says:

"Government specifications are drawn with a view to the consideration of price and quality. For manufactured articles and materials of constant and uniform quality they generally can be reduced to a clear statement of what is desired. For coal, however, the variation in character makes this impracticable.

"This lack of uniformity is the feature recognized and provided for in the coal specifications prepared by the geological survey. Under these specifications, bidders are requested to quote prices on the various sizes of anthracite, a definite standard of quality being specified for each size, and to furnish the standard of quality with price for bituminous coal offered. Awards are then made to the lowest responsible bidder for anthracite and to the bidder offering the best bituminous coal for the lowest price. The specifications become part of the contract, and the standards of quality form the basis of payment for coal delivered during the life of the contract. For coal delivered which is of better quality than the standard, the contractor is paid a bonus proportional to the increased value of the coal. For deliveries of coal of poorer quality than the standard, deductions are made from the contract price proportional to the decreased value of the coal. The actual quality and value of coal delivered is determined by analysis and test representative samples taken in a specified manner by agents of the government and analyzed in the government fuel-testing laboratory in Washington. The necessity of paying for coal on a sliding scale was fully discussed by D. T. Randall in a recent paper."

Advantages of the System.

The advantages of buying coal on specifications are explained by Mr. Burrows, as follows:

"The advantages of this system of purchasing coal may be briefly summarized as follows:

"Bidders are placed on a strictly competitive basis as regards quality as well as price. This simplifies the selection of the most desirable bid and minimizes controversy and criticism in making awards.

"The field for both the government and dealers is broadened, as trade names are ignored and comparatively unknown coals, offered by responsible bidders may be accepted without detriment to the government.

"The government is insured against the delivery of poor and dirty coal, and is saved from disputes arising from condemnation based on the usual visual inspection.

"Experience with the old form of government contract shows that it is not always expedient to reject poor coal, because of the difficulty, delay and cost of removal. Under the present system rejectable coal may be accepted at a greatly reduced price.

"A definite basis for the cancellation of contract is provided.

"The constant inspection and analysis of the coal delivered furnishes a check on the practical results obtained in burning the coal."

Necessity of Uniform Standard.

A few years prior to the adoption of the present system the necessity for a uniform standard in the purchase of coal became apparent to a few of the government departments, and the plan of purchasing on the heat-value basis was introduced. It proved successful, especially in the treasury department, under which purchases are made for the postoffices and other public buildings throughout the United States. The treasury department had at that time a well-equipped laboratory and was thus enabled to do all of the necessary testing. Other departments were unable to follow the example of the treasury because of lack of information and proper facilities. In 1904, at the Louisiana Purchase Exposition at St. Louis, the geological survey began a comprehensive study on a practical scale of the utilization of coal, J. A. Holmes being placed in charge of the work. These investigations are still in progress at Pittsburg, Pa., and they have resulted in making authentic information of great practical value available to the public as well as to the government departments.

This work led up to the development of a general and uniform specification plan for purchasing the government fuel supply.

STEAMER FOR GEORGIAN BAY SERVICE.

A steamer, not of large size, but with several exceptional features about her, known as the Simcoe, and built by Messrs. Swan, Hunter & Wigham Richardson, Ltd., at their Neptune Works, Newcastle, for the Canadian Government, left the Tyne last month for Canada. She has been specially built for lighthouse and buoy work in Georgian Bay, and when on service will frequently have to go amongst ice. Safe navigation under such conditions has therefore been kept carefully in view in her design and throughout her construction. She has special appliances for dealing with the heavy buoys which will have to be lifted up, taken to shore for repairs, and laid down again. The principal machine for this purpose is a large winch, which, with its special derrick, will lift no less than 40 tons. There is also arranged a well between the forecastle and poop of the steamer, where these large buoys can be safely and conveniently carried.

Extremes of temperature will be encountered by the vessel on her service, and the accommodation has been designed to afford the utmost comfort to those on board during hot and cold weather. In addition to the accommodation for crew for working the vessel, special well-finished accommodation is provided for the various officials of the Canadian government, whose duty it may be to inspect the various lighthouses, etc.

For use on her special service, the Simcoe will be fitted with an installation of wireless telegraphy, and she is supplied with a steam launch.

The Simcoe is a steel vessel, 180 ft. in length by 35 ft. beam, with a poop in which is placed the accommodation for the officers, engineers and officials, and a forecastle containing the crew. The steamer is propelled by twin-screw triple expansion engines, supplied with steam from two Babcock & Wilcox watertube boilers. On the trial trip, a few days before she finally left the Tyne, the propelling machinery worked without the slightest hitch, and the vessel attained an average speed of nearly 12½ knots. The Canadian government were represented on the trial trip by Mr. C. Duguid.

JAPANESE MERCANTILE MARINE.

The number of Japanese merchant steamers in 1899 was 3,536, representing an aggregate burthen of 768,538 tons. In 1908 the number of steamers had increased to 6,098, and the aggregate burthen to 1,494,676 tons. The progress of Japanese steam shipping in the last 10 years was as follows:

Year.	Steamers.	Tons.
1899	3536	768,538
1901	4534	902,190
1903	4624	977,308
1905	5089	1,260,087
1907	5784	1,462,718
1908	6098	1,494,676

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Tribute to Rear Admiral Melville*

THE honor of being invited to pay a tribute to my dear old chief, Admiral Melville, is one which I appreciate highly, as well as the allied one of acting as spokesman for the donors of the splendid portrait which is to be presented to the National Gallery this evening. I admire the admiral as the fine flower of a splendid type of manhood, and his kindness to me for many years has been so like a father's that with a son's affection I rejoice at this splendid testimonial to his personality and his work.

Too often the pathway to greatness and fame is marked by the wreckage of competitors, and even friends, who have been ruthlessly thrust aside in the egoism of selfish ambition. Then, there may be a grudging admission of ability, but there is no love, no true admiration. When on the other hand, the hero has always been the helper and friend of his companions, when he has cheerfully acknowledged their aid to his success, we have such greatness as we are celebrating tonight. Then, every member of the profession feels that the fame of the leader is reflected on the whole body, and they love the man while they rejoice in his reputation.

George Wallace Melville is such a man. He has been one of the famous men of engineering so long that we find it hard to remember a time when his name was not synonymous, as it is now, with all that represents progress and achievement in our profession.

It is a matter of delight to all of us who love him that the artist, in the picture which is to be presented to the National Gallery this evening, has faithfully depicted the chief characteristics which have made him great. These are, in my judgment, indomitable courage and unbending honesty. It is possible for a man to have great mental ability and yet fail of true greatness if he lack these essentials.

Melville's Arctic Record.

You all know Melville's Arctic record which first brought him an international reputation; there he displayed a heroic courage which has never been surpassed, and for which congress advanced him a grade in the navy. This, however, was only a repetition of other instances of absolute fearlessness, beginning with his earliest days in the service. When he became engineer-in-chief, the same courage, but rather on the moral than the physical side, was shown. Beginning with his first annual report, he spoke out fearlessly, setting forth the truth, as he saw it, and striving always for advancement and efficiency. Complaint was made to President Cleveland of the plain speech in this first report, but that strong man read it himself and said, "We want more such men."

His professional courage is also remarkable, and along with this is a faculty, which I believe is a characteristic of all great men, that having made his decision he does not worry about the result. Able men of minor rank are always fearful that something may go wrong and their reputation be injured. The really big man does not believe himself infallible. He knows that all men who do things will make some mistakes, and he is strong enough not to dread them. A notable instance of this kind in Melville's career was his use of triple screws for the Columbia and Minneapolis. I saw letters from some of his friends, for whose professional opinion he had the highest regard, urging him not to make the experiment, but he had studied the problem carefully, was satisfied with the correctness of the solution, and persevered. The result was perhaps the greatest triumph of his professional career.

His Executive Ability.

His ability as an executive was of a very high order. The feature of deciding a case and then refraining from worry is an evidence. He had a rare talent for choosing able assistants, and having proved them he left in their hands all the detail work, thereby giving himself time for careful study of the larger problems. The effect of this was very marked in stimulating the entire staff to the highest efficiency and zeal. I have known them all personally, and every man counted it a pleasure to work, without regard to hours, for the credit of the "Chief" and the glory of the service.

With respect to his professional work, it is notable that his career as engineer-in-chief of the navy, from 1887 to 1903, is the longest on record. It covers the building of the "new navy", and the Spanish war. During this time he was responsible for new designs of machinery for about 120 vessels, among which were 24 battleships and 41 armored vessels. Best of all, there were no "lame ducks" and no failures.

I will mention briefly some details of his more important work. He was the first to use water-tube boilers in large war vessels and to determine the actual coal consumption by trials. He was also the first to use the method of determining trial-speeds, known as the "standardized screw", which is the simplest, most accurate and inexpensive, and fairest to the contractor as well as to the government.

It is to him also that we owe our first high-speed battleship. When in 1898 the proposals for the Maine, Missouri and Ohio were being prepared, he stood alone in his demand for 18-knot ships. If he had not persisted, we should have been three years longer behind the other navies of the world in battleship speed.

Proposed Dreadnought Type.

It is very interesting to note also that only a little after this he proposed an "all-gun one-caliber ship"; in other words, what is now called the "Dreadnought" type. Before I left the service, I had often heard him talk of this big ship with ten 12-in. or 12 10-inch rifles and 19 or 20 knots speed; and about 1899 he submitted a sketch plan of the battery of such a ship to the board of construction. Possibly the same influence which almost prevented the 18-knot battleships prevented consideration of this more advanced type. At all events Melville was in advance of the general naval mind, and our country lost the credit for the introduction of this revolutionary improvement which it might have had several years before the "Dreadnought" was disclosed.

During the war with Spain he brought out the repair ship and the distilling ship. The idea of the former was not new, but the Vulcan was by far the most complete vessel of the kind equipped up to that time. The latter furnished fresh feed-water to the boilers and enabled a vessel with a storage bunker capacity of 3,000 tons to supply 60,000 tons of water.

A clever piece of work at this time was the fitting of new boilers to some of the old civil war monitors to enable them to be used for harbor defense. For years Melville had advised the navy department that new boilers must be supplied before these vessels could be used. When the destruction of the Maine made the outbreak of hostilities seem probable, the makers of water-tube boilers submitted estimates of time and cost for the work. Boilers were

*Address by Walter M. McFarland in presenting a portrait of Rear-Admiral Melville to the National Gallery, Washington, May, 1909.

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promised in 30 days, but it was necessary to use the standard land type. As these vessels were not to go to sea, however, this was satisfactory. The wornout boilers were cut up and passed out through the smokepipe because the armored deck could not be taken up; the new boilers were passed down the smokepipe in sections and erected on board; finally each of the boats was given a steam trial, which was entirely successful.

A great deal of experimental work was done under his direction, all of which is published in his annual reports. The last of such experiments was a series of tests of oil-fuel, probably the most comprehensive ever made.

My brief sketch of this famous man would be incomplete if I failed to speak of his personality. The lion-like head and the frank speech have led some to say that he is one of the old "Vikings", spared to us a thousand years after the others have gone; but if this leads any to think that he is harsh and cold, there could be no greater mistake. Like all strong natures, he is pronounced in his feelings, but he is a man of warm affection, and when he has once taken you into his heart, you are sure of an abiding-place there as long as you are worthy. It is often said that no man is great to his intimates, but I have been with him, day by day, for years; have seen him under all conditions; and my admiration and love for him have simply increased as the years go by. I have no ambition to be a Boswell and I have not kept notes of his doings; but I have seen the daily workings of a great, kind heart, tender for the humble yet fearless toward the great; and I can truly say that I count it a privilege and an inspiration to have been a trusted friend and helper of this noble man, who has exemplified the highest type of manhood and added now luster to the profession of engineering.

Acceptance by Dr. C. D. Walcott.

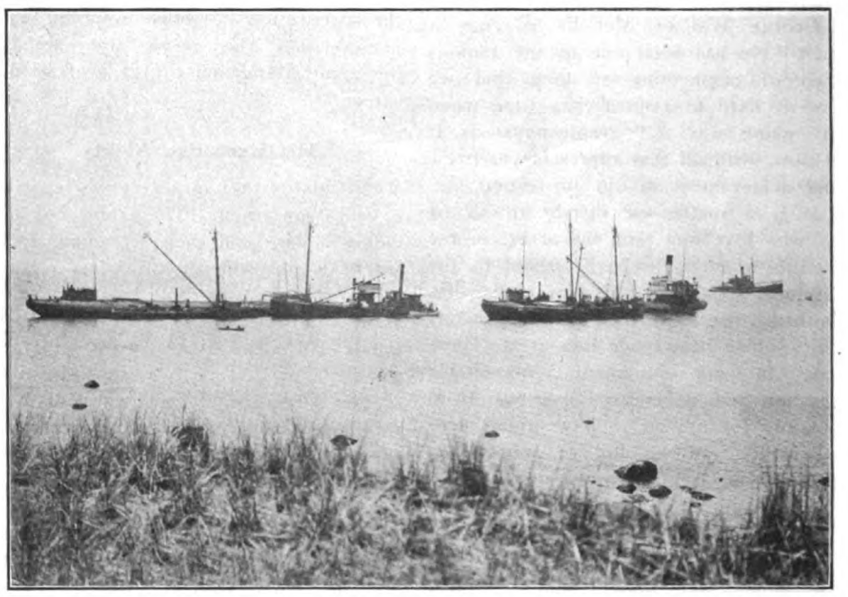
It gives me pleasure, speaking for the Smithsonian Institute as the custodian of the National Collection of Art, to accept from you for the people of this country this fine portrait of Rear-Admiral George Wallace Melville, to be exhibited in the gallery of portraits of Americans who have achieved eminence in their life work.

Among the men who have rendered distinguished service to their country in literature, science, or art, in war or in peace, in professional or civil life—few have won such well-merited distinction in so many lines of duty as Admiral Melville. He stands high in the regard of the nation as a naval hero, as an engineer of exceptional ability, and as a wise and resourceful administrator and advisor. It is only to be regretted that, under the operation of law governing retirement, Admiral Melville was obliged to retire from active duty in 1903, but it is to be hoped that the country which he has so efficiently and actively served may long be permitted to enjoy the benefits of his counsel.

The portrait of Admiral Melville is a most appropriate addition to this National collection and it is peculiarly fitting that his services should be emphasized in this happy manner by a society which embraces so distinguished an array of men in the engineering profession, a society that for nearly 30 years has exercised a powerful influence toward unity of interest and harmony of purpose in the broad field of American engineering.

WHALEBACKS GROUNDED ON THE COAST.

The accompanying picture shows the whaleback steamer Bay City and barge Britannia on the rocks at Block Island, Rhode Island. They went ashore at 5 p. m. Sunday, May 16, during a thick fog. Capt. McCarthy of Detroit, port captain of the line, who also took the Bay City from the lakes to the coast, represented the owners in the wrecking operations. The Scott Wrecking Co. contracted to raise the barge and the Merritt-Chapman Wrecking Co. the steamer. The Britannia after lightering some of her cargo of coal was ready for a pull at high water on May 19. Capt. Uberroth of the revenue cutter Gresham volunteered his service and the Gresham assisted by the tug Tosca dragged the barge afloat after much hard pulling. The vessels had gone on at high tide and were well up onto shore. Extra pumps were found necessary to pump out the Bay City. The arrived on May 21 but a northeast gal having in the meantime set in blowing fifty miles, with a heavy sea running, it was necessary to suspend operations. The Bay City floated on May 25.



WHALEBACK STEAMER BAY CITY AND BARGE BRITANNIA STRANDED ON BLOCK ISLAND.

REVIVAL OF COAST SHIP BUILDING.

Ship building conditions on the coast, especially in relation to construction for the Pacific coast, appear to be improving rapidly. The American-Hawaiian Steamship Co. has just awarded contracts for three new steamers to cost approximately $1,750,000 to the Maryland Steel Co. for its service between New York, San Francisco and Hawaii. The Ocean Steamship Co. (Savannah Line) has closed contract with the Newport News Ship Building & Dry Dock Co. for two new coastwise liners to cost approximately $500,000 each. The steamers are to be 379 ft. long and 49 ft. 6 in. beam with accommodations for 235 passengers and 3,500 tons of freight.

The Newport News Ship Building & Dry Dock Co. is also building two steamers for the San Francisco & Portland Steamship Co. to be 380 ft. over all, 47 ft. beam and 34 ft. deep. The Newport News Co. has also received an order to build an oil-burning tank steamer for the Associated Oil Co. of San Francisco. This tank

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WARSHIPS OMITTED IN RECENT PROGRAMS OF NAVAL CONSTRUCTION.*

BY THE RIGHT HON. LORD BRASSEY.

IT is an obvious remark that it is in vain that parliament should vote lavishly for the navy if the money is ill-spent. Unanimity of professional opinion in relation to construction is weighty, though perhaps less conclusive than some may think. It has been reached, not as the result of independent investigation, but by imitation of British designs.

To the British admiralty belongs the credit of producing the first specimen of a new class of battleship, showing a marked advance over all preceding types in speed and in guns of the heaviest caliber. The coal-endurance is sufficient for ocean passages. Occasions may arise in naval warfare when superiority in speed and big-gun armament might decide the issue. It is necessary to secure a preponderance for the British navy in Dreadnoughts.

It is not inconsistent to contend that other types besides the Dreadnought are of great value for the line of battle. We see in recent naval construction a continuous increase in dimension and in cost:

	Displacement. Tons.	Cost (including guns.) £.
Lord Nelson	16,500	1,654,098
Dreadnought	17,900	1,813,100
Temeraire	18,600	Not given in navy estimates. In round figures possibly £2,000,000.
St. Vincent	19,250	
Neptune	20,000	

The latest battleships designed for Germany, the United States, and Japan are ships of 20,000 tons.

In his recent volume on naval administration, Capt. Mahan insists on the objections to continual increase of dimensions: "When a certain speed has been attained, a small increment must be purchased at a very great sacrifice. What shall the sacrifice be? Gun power? Then your vessel, when she has overtaken her otherwise equal enemy, will be inferior in offensive power. Armor? Then she will be more vulnerable. Something of the coal she would carry? But the expenditure of coal in ever-increasing ratio is a vital factor in your cherished speed. If you can give up none of these things, will you increase the size? Will you have smaller numbers with larger individual power? Then you sacrifice power of combination!"

There are considerations in connection with armaments. "The main instrument," says Sir Cyprian Bridge, "is the gun, and it is its fire that has to be concentrated. If the ships are distributed at suitable intervals, the enemy's return fire must be either divergent or be only imperfectly concentrated. * * * The mounting of very heavy armaments in single ships reduces numbers. * * * This constitutes an obstacle to the desirable tactical dispersion." So, too, Sir Reginald Custance. In his chapter on the Battle of Tsushima, the gallant author shows how "the fire of 63 guns was concentrated on the leading ships of the Russian line. Shells rained on their decks. They were enveloped in a sheet of flame. The great principle of dispersing the guns to concentrate their fire was emphasized and confirmed."

With increase of dimensions we have not secured invulnerability. It is not possible to protect the whole area of side above water with impenetrable armor. In the war in the Far East, the mine was a deadly weapon.

If we were creating a new navy for the defense of the British empire, it would be desirable to lay down a proportion of ships of moderate dimensions. We are relieved of this necessity. We have, as Mr. McKenna has said, a mighty fleet of ships earlier than the Dreadnought. The forthcoming volume of the "Naval Annual" will give a list of 44 British battleships. Classing the Lord Nelsons for the time being as Dreadnoughts, we have no less than 38 other ships, of which the oldest was launched in 1894. Collectively, these ships carry 144 12-in. guns, 8 10-in. guns, 32 9.2-in. guns, 28 7.5-in. guns, and 428 6-in. quick-firers. They are heavily armored. Speed 18 to 20 knots an hour. With brave and well-trained men behind the guns, and under the command of captains reared in a service which has no record of failure, we have a fleet of vessels which well answer in these latter days to the two-deckers of the glorious past.

It is not necessary to dwell on the armored cruisers. The type has disappeared from the latest programs of construction. Equal in dimensions and in cost, with a slight inferiority in armament and armor, but with a steaming power equal to 25 knots at sea, the four ships of the Invincible type, and the Indefatigable, should certainly be included in the Dreadnought class in any comparison of naval strength. Armored cruisers cost as much per ton as battleships. Our appropriations to cruiser construction have not been approached under any other naval administration. In the view of many naval authorities, it would have been well to have spent less on armored cruisers and more on battleships.

The large protected cruisers are the latest effective of all the ships on the British navy list. It is a waste of public money to keep such ships as the Powerful and Terrible in commission. They carry large crews. They are too vulnerable to be reckoned as fighting ships.

It remains to refer briefly to the inshore squadron. The Dreadnoughts are essentially ships for the open seas —beyond the range of the torpedo, and free from the danger of the floating mine. In narrow and shallow waters, in the southern part of the North sea, with all lightships and buoys removed, navigation would be hazardous in the extreme. At night, and in thick weather, the torpedo would become a most formidable assailant. The gun is a useless weapon against an invisible foe. The naval experience and professional skill which have produced our noble fleets for the open waters should now be directed to the creation of a type specially designed for the inshore squadron.

We are strong in destroyers and submarine boats. The Monitor, the armored ram, as designed by Admiral Ammen, U. S. N., and the protected torpedo vessel, as exemplified in our own Polyphemus, are types of a past era, but which must still be found effective in modern warfare.

It is hardly possible to close without a reference to pending discussions of today. We must look to the future. We must add to the expenditure on construction. We are strong in ships. The amounts voted for Great Britain, Germany and the United States are approximately the same. In Germany one-half, in the United States one-third, in Great Britain one-fourth of the amount voted for the navy is available for new construction. We cannot keep ahead without further effort.

*Abstract of a paper read before the Institution of Naval Architects.

A pilot chart of the South Atlantic Ocean which should be of the greatest assistance to vessels navigating in these waters is now being issued by the United States Navy Hydrographic Office. This chart can be obtained by mariners, free of cost, by applying to the Branch Hydrographic Office at 78-80 Broad street, New York City.

James H. Woods has been appointed assistant general sales agent of the Pittsburg Coal Co., at Cleveland.

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"In the Merchant Service"

THE second engineer of the Alroma had taken up his accustomed position in the doorway separating the engine and boiler rooms and was watching with languid interest the maiden efforts of a couple of green coal passers in the after boiler room. The Alroma had been under way but a few hours, and, as the second engineer had been up and around most of the past 36 hours, he didn't enter into the crew-straightening-out process with the enthusiasm which would later distinguish the efforts of his subordinates. His ruminations were rudely disturbed, however, by one of the aforesaid coal-passers accidentally spilling the contents of the clumsy barrow right at the feet of his superior.

"What the devil are you trying to do," snarled the second, "break my blessed legs?" He reached down among the scattered coal and menacingly aimed an unhealthy-looking lump at the retreating form of the coal-passer. The coal was never thrown, however, as something about its appearance awoke the slumbering professional instinct of the engineer. He examined the pile of coal at his feet, the coal in front of the furnaces, peered into the bunker, then made his way into the engine room.

"How's she turning up?" he asked of the man in charge of the propelling machinery.

"Couldn't be much worse," said that individual cheerfully, adding "she's shut hard in as yet."

Later, when the chief engineer, pacing back and forth at the engine room door on deck in the full realization of the responsibility of his first trip in charge, happened to glance into the engine room he was surprised to see a disgusted-looking second engineer hovering around the "tops." With becoming dignity he obeyed the second engineer's appealing glance.

"What brand of coal are we supposed to be burning this trip, Mr. Carson?" asked the aggrieved second engineer, as he mopped a dirty and perspiring face.

"Why, that's a new supply," answered the chief, "it's listed as P. X. V."

"P. X. V.?" murmured the second, ponderingly, "I can't say I ever heard of it."

"It's an experiment," the chief explained, "they told me in the office that it was a very economical coal."

"Oh, it's economical, all right."

"Think so?" asked the new chief, anxiously.

"Sure," answered the second, with a hollow laugh. "It's so darned economical that we will have the most of it still in the bunkers when we reach Liverpool—if we ever get there."

The chief shook his head sorrowfully. "Just my luck," he said. "They give me charge of the oldest hooker in the fleet, fill the bunkers with poor coal and expect us to keep in the running. I tell you what you might do, Mr. Jones. Pick out the bad pieces you happen to run across, and stow them away until we get to the other side. We'll let the superintendent see what kind of junk we had to steam over with."

That evening, at the relief of the watch, the second engineer gave the fourth his opinion of the coal, the Alroma, her owners and other matters, to all of which the fourth listened with respectful attention.

"What's in the bag?" asked the fourth, as a coal-passer, after sweeping out the passageway, carefully deposited the sack of sample coal in a corner.

"Oh, that is some of the coal we are carrying," said the second, carelessly. "The old man asked us to stack the worst of it." And feeling that he had done all that could possibly be expected of him, he departed up the ladder. The fourth was relieved at midnight by the tired and taciturn third.

"What's in the bags?" asked the third, as he ran his eye over the several sacks of coal stacked in the pass.

"Rotten coal," said the fourth, briefly, and to the point.

"What's it doing here?" the third growled.

"Why," answered the fourth, vaguely, "the second said something about the 'old man's' wanting to save all the bad coal we come across."

"More blamed foolishness," commented the third, as the fourth departed.

At 4 o'clock in the morning the second stood in the passageway between the engine and boiler rooms. He was staring in astonishment at two rows of coal-filled ash bags blocking the passage as he awaited the arrival of the third.

"What's this supposed to be—a spare bunker?" he asked of the grinning third.

"No," was the answer, "I understood that you wanted all the rotten coal saved, according to the word the fourth passed on to me. Later I found that if you really want all the rotten coal saved you would have to shut down the bunker doors and set sail on the old packet. It's all rotten."

"Well, we'll throw that stuff on the plates. I'll bet you that when the chief gets to Liverpool he won't do a thing but raise hell generally. He always was a crank on the matter of coal, anyway."

For ten days and ten nights the engineers of the Alroma experimented with the coal in the bunkers. All styles of firing hitherto known were tried, as were several styles hitherto unknown. Incidentally, between times, they made guesses as to the wording of the "old man's" report to the company, banking on his past performances when a second.

When the Alroma crawled into port the third and fourth engineers saw the engines shut down, wiped down, and the men knocked off. Arriving on deck they met the chief's boy with the log sheets and like matter.

"Say, son," said the third, "let's have a look at the coal report."

"I'll bet it's a hot 'un," chuckled the fourth.

The third backed up to a port hole from which the lamp light was streaming, held up the sheet of paper and prepared to give the fourth and himself a treat.

"Name of coal," he read aloud, "P. X. V."

"Let 'er rip," encouraged the fourth.

"Quality—poor." Then the third silently handed the waiting youth the report of their fallen idol.

"Well," commented the fourth, "he might at least have said rotten."

THE "STAND-BY" MAN.

Mr. Louis H. Washburn has been appointed eastern sales agent of the Pittsburg Coal Co., with offices at the United States Express Co. building, 2 Rector street, New York. The arrangement under which B. Nicoll & Co. have been representing the Pittsburg Coal Co. as eastern sales agents has been discontinued.

Secretary of the Navy Meyer has ordered the removal of all figure heads on war ships, because the figures interfered with maneuvers during battleship practice.

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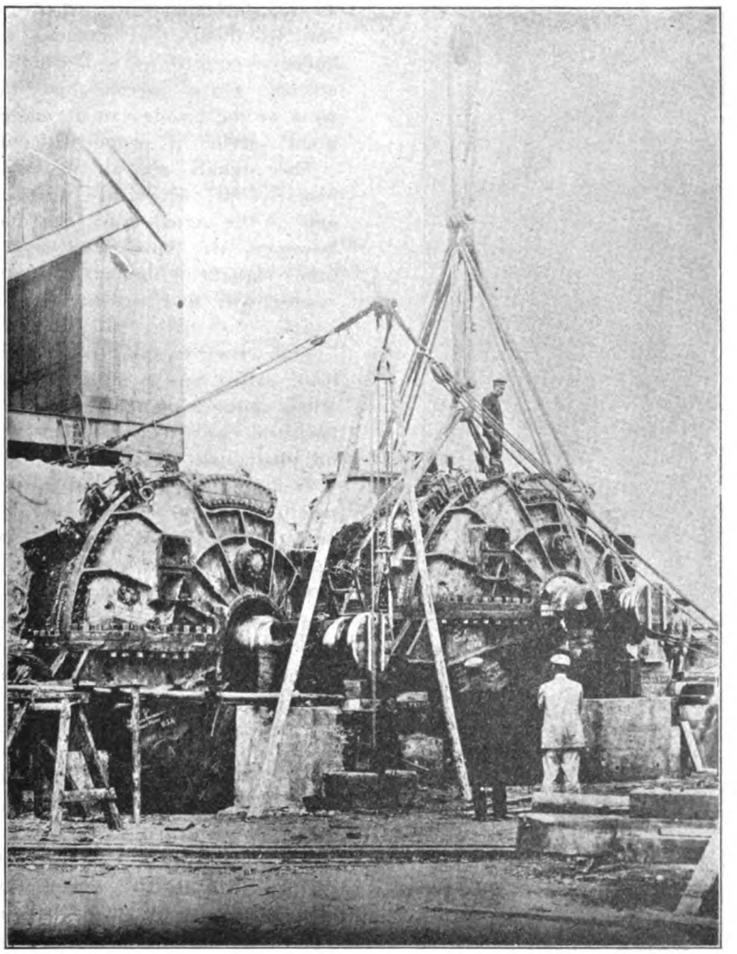

CURTIS TURBINES OF JAPANESE CRUISER IBUKI.

CURTIS TURBINES FOR JAPANESE CRUISER.

Herewith are published two photographs taken in Japan of the 12,000 B. H. P. Curtis turbines which were furnished for the Japanese cruiser Ibuki by the Fore River Shipbuilding Co., Quincy, Mass. These turbines were shipped in sections and assembled on the dock at the Kure navy yard and hoisted in one piece on board the ship. A similar pair of turbines will be installed on the Japanese battleship Aki.

BOOK REVIEWS.

The Copper Hand Book. By Horace J. Stevens, Houghton, Mich. 1,500 pages. Price $5.

This book gives a detailed description of the copper mines of the world, embracing no less than 6,767 copper mines and copper companies. The book purports to be an encyclopedia on the entire subject of copper. The chapters are devoted to the geology and minerology of copper, its mining, milling, smelting, leaching and refining. It is intended to be useful to the miner, metallurgist, producer and consumer, as well as to the investor.

The Story of the Great Lakes. By Edward Channing and Marion F. Lansing; 398 pages, 5 x 7½ and numerous illustrations. The McMillan Co., 66 Fifth avenue, New York, publishers. Price $1.50 net.

This book is practically devoted to the early days of the great lakes, its reference to present day conditions being incidental and fugitive. The commerce of the great lakes, which constitutes its real romance, is but briefly touched upon. The book, however, is interesting and valuable as a recital of the discovery and exploration of the great lakes by the early French explorers. Champlain and his followers were certainly a venturesome band of Frenchmen and have left behind them a history full of picturesque qualities. The book is divided into three parts, the first of which is devoted to the period covered by the advent of Champlain and LaSalle. The second part relates to the founding of Detroit and covers the conspiracy of Pontiac, the war of 1812 and the various treaties with the Indians by Gen. Lewis Cass and others. The third part describes the influence of the Erie canal and touches upon more modern development. No attempt has been made to give details, however, merely the important events of each period being chronicled. This book would be an excellent aid to a more complete history of the great lakes. It gives a valuable list of books which have been consulted in the preparation of the work. This is a most useful feature. The index too is quite thorough.

GERMANY'S NAVAL PROGRESS.

The recent launch of the 4,300-ton cruiser Mainz, of 25.5 knots nominal speed, recalls to mind the steady progress which Germany has made for this class of vessel since 10 years ago, when, notwithstanding the apparent depreciation of the protected cruiser, she adhered to the Gazelle type. Commencing modestly with a 2,600-ton unit of only 19 knots speed, this series now comprises seven vessels, which have exceeded 21 knots on trial, six of which have done over 23 knots, and six others 24 knots, forming the most homogeneous scouting fleet in the world. Tonnage has increased 80 per cent, and the number of knots 20 per cent; but one important item has remained curiously unchanged, viz., the caliber of the guns, which are of the 105 mil. bore, 10 and 12 in number, and firing at a rate of nine per minute shells of 14 and 18 kilos., thus being an ideal armament against torpedo craft.

SHIP BRAKE.

A new brake, designed to bring vessels traveling at a high rate of speed to a quick stop, is soon to be given a test on the battleship Indiana. The inventor of the device claims that it will bring a vessel running at the rate of 20 knots an hour to a full halt in a few seconds, and the navy department has issued orders for the experiment to take place. The device is made up of two large wings, fastened by hinges to each side of the ship below the water line, which, when not in use are held close to the ship's sides, and are 13 ft. high and 6 ft. wide. When the stop is desired the wings are forced open by means of hydraulic power, until they are at right angles to the sides.

The Hamburg-American liner Cincinnati reached New York on June 7 on her maiden trip. She is a sister to the steamer Cleveland which arrived a few weeks ago and is therefore 608 ft. long, 65 ft. beam and 55 ft. high from the water line to the upper deck.

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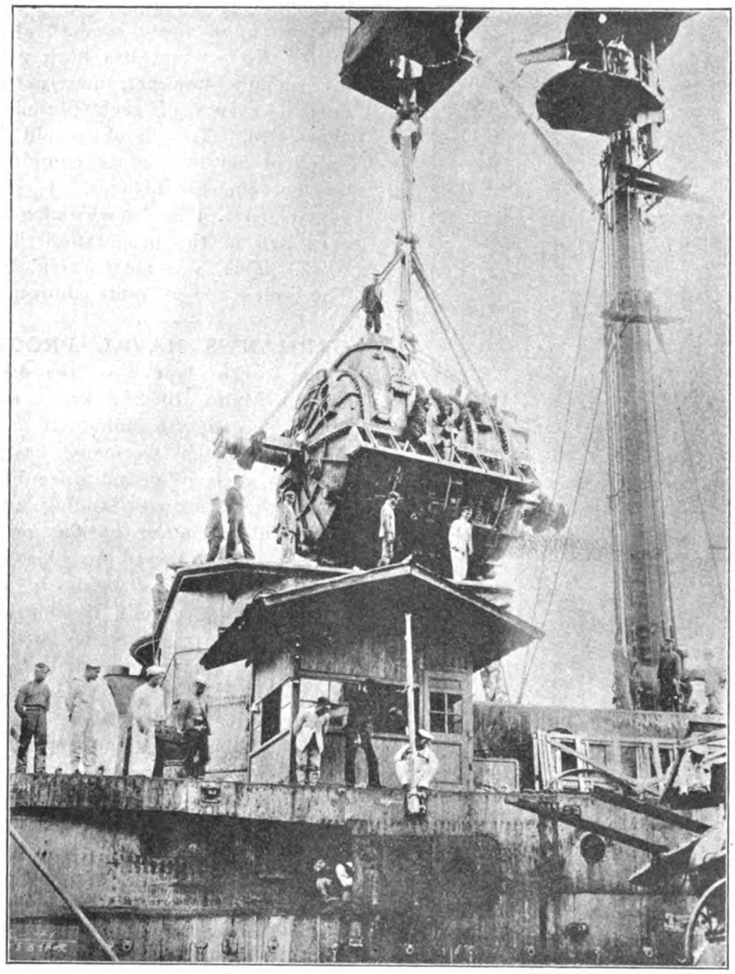

HOISTING THE TURBINE ABOARD THE JAPANESE CRUISER IBUKI.

Signaling in Our Merchant Service

Editor MARINE REVIEW—This is a subject upon which practically nothing has been written or said in this country. And why is it? Numerous articles written in foreign marine journals from time to time, invariably mention the fact that we are far behind any other nation in this necessary branch of our nautical profession.

And this state of affairs has always existed and will continue to a certain extent until American owners insist on their officers being up-to-date and keeping pace with modern practice and improvements. In addition senior officers should encourage in every way possible the efforts of the juniors when they attempt to put any of the more modern ideas of the profession into use.

Numerous instances could be cited where American ships have actually passed foreign vessels flying signals of distress, the American simply dipping his ensign; in other cases ignoring the other vessel altogether; in fact any combination of flags looked alike and the very act of unearthing the signal book seemed an overwhelming task and was done with reluctance.

It is time something was done to bring the American mercnant marine (that is, what little we have left of it) up to the same standard in signalizing as other countries and to do this it will be necessary for this government to adopt methods somewhat similar to the British board of trade in which all candidates for licenses are examined in night signaling as well as in flag signaling by day. The former method of signaling may sound new to some, yet night signals, using a flash lamp, has been in use by all foreign nations for at least six or seven years. Nearly all the Atlantic liners and a great majority of tramp steamers are supplied with a flashing lamp or some suitable makeshift and as regards substitutes there are no end to them, for instance, a large bullseye lantern or a 32-candle-power electric globe carried out into the wing of the bridge can be made to do good service if properly handled.

The signals are all made by the Morse code, which are given at the end of the signal book, the numerals, however, are omitted as are several other signals of importance which the reader will find at the end of this article.

The writer has on several occasions been called up at night by steamers while running on the China coast but being in an American *mail boat* had not the means of answering the other vessel, the other vessel probably a tramp, evidently remarking that it "must have been a Yank" he had called up.

It is a well known fact to all Americans that have been abroad that we are held up to ridicule for our inefficient signaling by day and lack of any means for signaling by night.

While the Boer war was in progress several of the large English transports were greatly humbugged one night near Cape Town simply because of their inability to take in and send signals while in company with an English man-of-war. That was several years ago; since then night signaling has become quite common in the British merchant marine.

The same thing could easily happen to us in time of war so it behooves the American officer that if he does not want to be caught napping he should give this important subject the attention it merits.

Following is the Morse code:

Morse Code.

a . —	n — .
b — . . .	o — — —
c — . — .	p . — — .
d — . .	q — — . —
e .	r . — .
f . . — .	s . . .
g — — .	t —
h	u . . —
i . .	v . . . —
j . — — —	w . — —
k — . —	x — . . —
l . — . .	y — . — —
m — —	z — — . .

Numerals.

1 . — — — —	6 — . . . .
2 . . — — —	7 — — . . .
3 . . . — —	8 — — — . .
4 . . . . —	9 — — — — .
5	0 — — — — —

. = flash of about ½ second.
— = flash of about 2 seconds.

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Allow pause of 4 seconds between letters or numerals and 6 seconds between sentences.

To call attention=. . . . . .

Answer, or I understand= — . — . — . — . — . —

Numerals follow, or ended=. . — . . .

Finish of message . . . — ., to be answered by R. D. as separate letters if message is understood.

Repeat=. . — — . .

Ready to receive= — — .

Stop= . . . . . .

Light or lamp to be kept burning while receiving message unless the receiver should fail to understand a letter or word when he should darken (deaden) light at once, the other, noticing this, will repeat the last word or group of letters. If the receiver wishes the whole message repeated he should darken his light, call the other vessel up, and signal U. R. J. This is taken from the signal book and means "Repeat the message."

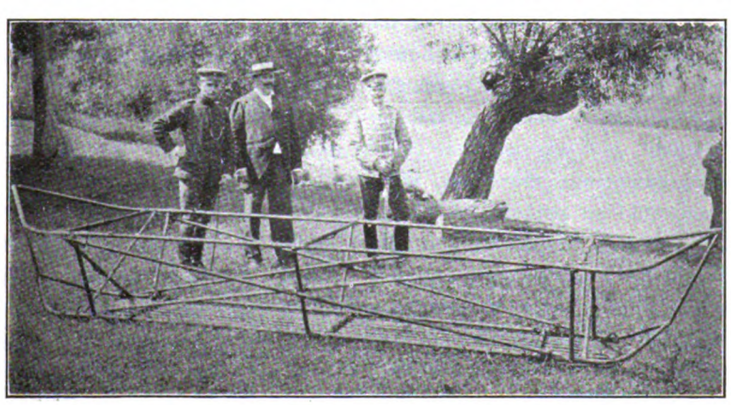
The signal book should be used in all cases. FIRST OFFICER.

San Francisco.

EMERGENCY BOATS.

The photographs accompanying this article illustrate a novel means which has been devised for quickly crossing streams by the advance guard of an army. Advance cavalry frequently has to cross rivers to search the country before the main body approaches. Obviously they cannot wait to build a bridge or carry heavy boats with them. An invention made by a German merchant appears to solve the difficulty. The folding boat illustrated herewith is constructed out of the lances used by the cavalry and covered with a water-proof cloth. Sixteen lances are required for one vessel. The boat can be assembled within four minutes by six soldiers and will carry sixteen men with arms and the harness of their horses. The lances also serve as oars, the blades being constructed of flat pieces of wood covered with cloth. The horses, of course, swim across the stream. Upon reaching the shore the boat can be knocked down in two minutes. The capacity of each boat is 3,600 lbs.

TRIALS OF FOLDING BOATS BY GERMAN SOLDIERY.



SKELETON OF THE FOLDING BOAT CONSTRUCTED OF LANCES.

LAKES TO THE GULF WATERWAY IMPRACTICABLE.

The board of engineers consisting of Col. W. H. Bixby, Lieut. Col. C. McD. Townsend, Lieut. Col. J. G. Warren, together with Messrs. H. B. Richardson and H. P. Ritter, of the Mississippi River Board, have reported that the lakes to the gulf waterway which has been vigorously advocated by the city of Chicago is not practicable and not desirable.

The main features of the report are that (1) the engineers doubt whether a 14-ft. depth is possible; (2) that such a depth, being too big for river craft and too small for lake craft, is an awkward proposition at best; (3) that the great river traffic in Europe, as on the Rhone, for instance, is handled in boats and barges drawing from 4 to 6 ft. loaded; (4) the present and prospective demands of commerce from Chicago to the gulf could be met by a 9-ft. channel; (5) that the natural line of river development is via the Ohio river into the Mississippi, instead of from Chicago to St. Louis; (6) that the present 8-ft. depth from St. Louis to the Mississippi mouth is sufficient to handle all the commerce in sight; (7) an 8-ft. channel from Chicago to St. Louis would be enough for all possible demands of commerce, present or prospective, and would be desirable if the cost should prove to be reasonable.

The engineers will make a new survey to see if an 8-ft. channel could be opened between Chicago and St. Louis at a reasonable cost.

The survey board discussed six methods which might be followed in experimenting to secure a 14-ft. waterway. The one nearest practicable would be a combination of dredging with movable dams and other regulation works. This would cost $128,600,00 from St. Louis to New Orleans, with an annual charge of $6,816,000 for maintenance. The 14 ft. from Chicago to St. Louis would cost an added $30,097,462, and an annual $310,000 for maintenance.

The bulk freighter Stadacona, building at the Ecorse yard of the Great Lakes Engineering Works, for the Inland Navigation Co., was launched on May 29 and christened by Mrs. R. O. Mackay, of Hamilton. The Stadacona is 500 ft. over all, 480 ft. keel, 56 ft. beam and 30 ft. deep. Her engines are triple-expansion with cylinders 22½, 36 and 61 in. diameters by 42 in. stroke, supplied with steam from two Scotch boilers 14 ft. 2 in. by 12 ft., equipped with forced draft and allowed 180 lbs. pressure. She will carry 9,500 gross tons.

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THE FACTS ABOUT THE TURBINE.

The MARINE REVIEW has consistently opposed the views so widely held as to the adaptability of the steam turbine to a wide field of service in marine propulsion, and has, on several occasions, taken issue with them, even though apparently upheld by those who might be assumed to speak with knowledge. Probably this condition is in no small measure due to the peculiar circumstances surrounding the early development of the turbine, its earliest applications being made in types of vessels especially designed for speed and thus giving it a somewhat spectacular *cachet*. Had the first turbine installations been made in vessels of the cargo type, it would in all probability have passed quietly away, but its success led, not only its sponsors but the lay public, to the making of extravagant claims on the one hand and indulging hopeless expectations on the other, which could not possibly be fulfilled. Fuel cost was to be cut in two; weights were to be greatly reduced; space requirements would be cut down and vibration would be unheard of. If we except torpedo boats and naval vessels and high speed express steamers, no one of these claims has been made good, and only partially in their case.

The history of the turbine afloat has been shrouded in mystery and mis-statement. Claims as to fuel economy have been made persistently which never have been reached, and even the figures quoted have not included the auxiliaries which are a necessary part of the steam plant and which cannot be separated from it, and which are invariably included in reports of the performance of reciprocating engines. Neither is there at hand any even approximately accurate record of actual performance. Feed water has been estimated from pump displacement, and coal from bunker measurements or from counting baskets as dumped on the fire hold floor. Such data falls a long way short of the vast amount of accurate information available from reciprocating engines, and the question of propeller efficiency, which is really the final word on the whole question, has been studiously avoided. As to vibration in particular, the turbine failure has been lamentable, though this was only to have been expected, since those who made the claims did so without knowledge of the true conditions, and are only now acquiring it at the cost of bitter experience, though warned times without number. This point we have covered at length heretofore, and shall again refer to it in the near future in connection with the general subject of engine balancing and hull vibration.

Turbine practice has been relatively limited in the United States marine, though enormous in stationary work, and the extensive experience of our friends in Europe is, therefore, of great value. We, therefore, commend attention to the article on "Marine Steam Turbines," from the London *Engineer* printed in full elsewhere. We think some of the information therein and the conclusions to be inevitably drawn will be in the nature of a rude surprise to many. It must be admitted to be eminently fair and might easily be extended to make it an even poorer case for the turbine, as, for instance, in pointing out that so far from the turbine displacing the ordinary or piston type in commercial vessels, even in the liner class, the latter now comes to the rescue of the turbine, as in the case of the Laurentic and the Otaki, elsewhere referred to. Mr. Parsons, only so long ago as 1907, unwillingly admitted this to be the best arrangement (for the turbine), while Prof. Rateau, of France, recommended and advised the plan at least five years earlier, but to deaf ears. Economies and improvement in propulsion of the liner and the cargo carrier will come and probably sooner than many think, but not by the turbine route, and when it does come, even the stronghold of the turbine, the naval vessel, will be lost to it.

IMPROVEMENTS IN BOILER DESIGN AND THE STEAMBOAT INSPECTION LAWS.

Structurally speaking the most perfect piece of apparatus is that composed of the fewest parts, and one of the marks of the successful designer is his ability to achieve his ends with the simplest forms, keeping in mind of course comparative costs. A steam boiler, however, is one of the structures where simplicity, represented by reduced number of parts, even at enhanced cost, is not only justifiable, but much to be desired, because every such reduction means elimination of seams and rivets and the "unavoidable weakest section." Thus, if we could build our boiler in one piece we would not only have the structurally perfect product, but the lightest and safest at the same time.

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A case in point is found in two boiler designs in the May number of THE MARINE REVIEW. It is not long since the shells of these boilers would have been composed of six plates; two courses of three plates each. A decided advance was made when heavy plates could be had of a size which reduced the number in each course to two, thus cutting out two longitudinal seams in each boiler. But the girth seam still remained and while not, strictly speaking, a weak point, it made permanently tight work very difficult, because of the underlying scarf of the butt-straps of the smaller course, as every engineer knows.

But the possibility of securing plates of a width which permitted the elimination of the girth seam, making a one-course boiler with only two plates and consequently two longitudinal seams, is a long step in advance, and it is entirely probable that before long we will have a single plate, single-seam boiler, and by means of the electric, oxy-acetylene, or Thermit welding processes, eliminate the butt-straps and rivets also. Welding the seam will, in itself, operate to make larger plates possible because of the consequent reduction in thickness due to a 100 per cent joint. It is true that under the law as at present constituted, the efficiency of the butt-joint is not considered, but the bill now pending which repeals all the moss-grown laws under which the board has operated and places the framing and enforcing of new rules entirely in the hands of the board will probably make rational rules possible and this is the only feature in which it is to be commended. As matters stand now, the law has no application whatever to a butt-strapped seam and we have the strange anomaly of a steamboat inspection law which does not apply to perhaps 90 per cent of the boilers actually built, and but for the integrity of the boiler builders themselves and the vigilance of the classification societies and insurance companies, the joint efficiencies might be anything at all. So far as actual control of the design of boilers is concerned the United States steamboat inspection law is a joke, and not a very good one at that.

IMMIGRANT TRADE.

That the steady increase in the trans-Atlantic immigrant trade which has taken place during the past six months is a generally accepted sign of returning prosperity there can be little doubt; especially when it is known that a large percentage of the immigrants passing through Ellis island are made up of those who took part in the wild exodus of 1908. At that time the outgoing steamers of the lines which cater especially to the steerage trade were packed to the limit with home-going laborers and mechanics of all foreign nationalities, and in many cases temporary lodging places had to be found or built for the surplus awaiting shipment. For the greater part of a year the embarkation of the panic-stricken continued, dying down eventually until the incoming and outgoing trade balanced, or nearly so.

The past four months of 1909 have seen vessels arriving daily at the port of New York with practically every square foot of steerage passenger accommodation taken, not to speak of a fairly respectable showing in the first and second cabins. When it is taken into consideration that the majority of these vessels are of modern construction and capable of accommodating on an average about 1,000 passengers, it will be seen that the trans-Atlantic trade is worth fighting for; so much so, in fact, that several of the companies operating vessels between this country and Europe have recently added to their fleet.

Competition is the life of trade, and, incidentally, is responsible for the luxurious passenger accommodations, tremendous freight capacities, life-saving and other equipment of the latest additions to the Atlantic ferry service. Among others might be mentioned the new Hamburg-American liner Cleveland, the Red Star liner Lapland, and the Atlantic transport liner Minnewaska. These vessels are of 18,000, 18,700 and 14,000 tons respectively, have accommodations for 3,250, 2,650 and 326 passengers—in the latter case the accommodations being exclusively for first class passengers—and have entered the service during the past two months.

Additions have been made to the fleet of nearly all the companies in the trans-Atlantic service during the past year. New York has been feted and dined month after month, on board the new vessels as they arrived at that city on their maiden trip. Gigantic and powerful, the very embodiment of all that is finest and best in modern ship building, these vessels have proudly steamed up the North river to their berths amid the roaring salutations of the horns on the craft engaged in harbor traffic or tied to the wharves. The press of this country has devoted no little space to descriptions of each new arrival, giving in detail all that is new in fittings and equipment and the history of the liner's owners.

We are an enthusiastic people. All that is grand and great appeals to us. The world-encircling voyage of our battleships, the plans for the Hudson-Fulton memorial celebrations or the friendly trans-Atlantic record-breaking competition of the two largest and fastest liners in the world all interest us to no little extent. We should not in our enthusiasm forget, however, that the great fleet of new vessels recently added to the trans-Atlantic ferry is entirely foreign. The United States flag flying aft on the new craft is conspicuous by its absence.

A NOTEWORTHY PRODUCTION.

Seldom has a paper attracted so much attention as that by C. Lee Straub on "Marine Producer Gas Power," read at the Washington meeting of the A. S. M. E. It has been reprinted more or less fully in almost every prominent engineering journal in the United States and is beginning to reach us in foreign reprints also. It was a valuable and timely contribution to current engineering literature, and will be more appreciated as time passes, and what now appears to be advanced, if not radical, ideas, are justified. It does not, however, involve any assumptions; the rival systems have been

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carefully and painstakingly worked out and the steam plant has been given credit for usual performance and no effort made at a forced showing.

THE MARINE REVIEW naturally finds gratification, not only in the fact that it anticipated any other journal in reproducing the paper, which it did in full, but also in that the paper not only substantiates, but even supplements, the figures and claims first set forth in the REVIEW two years ago, in which attention was particularly drawn to the great opportunities of gas power, more especially as applied to the bulk freighter.

As a direct result of our presentation of the case, frequently since emphasized, much attention was directed to the subject and nothing that has since transpired has called for any modification of the views then expressed, and Mr. Straub's able paper, coming from a recognized authority on gas production and combustion engines, clinches the argument.

BUCKNAM PASHA.

Probably few things are more injurious and less appreciated by a man of spirit than the average fulsome newspaper write-up. This is forcibly brought to mind by a recent article in a New York evening paper, of which the nero is R. D. Bucknam, who is doubtless well remembered by many on the great lakes. It is almost needless to say that either "Buck" was stringing the correspondent, or else had no knowledge of the matter as actually written. Doubtless there is a foundation of facts for many of the statements made, but it is doubtful if even Bucknam himself would recognize many of the incidents of his history in the story as printed.

From a sailor on the great lakes to Bucknam Pasha of the Turkish navy is certainly experience enough for the lifetime of the ordinary man, but at the rate at which Bucknam has made history, he has plenty of time yet to be the Sultan himself. The shape into which some of the incidents of his life have been magnified by the imaginative correspondents is amusing. For instance, the trimming of a ship in the harbor of Key West to remove a broken propeller is made an unheard-of feat, whereas it is done in almost every harbor on the coast and on the great lakes frequently, and was done before Bucknam was born. The correspondent attributes to an admiral of the United States navy, who witnessed the operation, the remark that it was one of the cleverest things he had ever seen done, which might easily be true. Long before Bucknam went to sea, ships had had not only their propeller, but tail shafts and stern tubes as well, removed without docking.

The correspondent also sends Bucknam to Chicago in 1893 to build the whaleback Columbus and sail her during the fair, and later to the Pacific coast to build the whaleback Sidney, all of which is correct, with the exception that the Columbus was not built at Chicago and Bucknam did not build her, nor did he sail her, nor did he build the whaleback Sidney on the Pacific coast for the reason that no such ship was ever built. He did, however, superintend the building of the City of Everett, at Everett, Wash., and sailed her on her round-the-world tour, to which reference has been previously made in THE REVIEW, all of which is merely by way of showing that, instead of adding to Bucknam's laurels, of which he has many, the correspondent has merely made him ridiculous.

REMOVAL OF THE CREOLE'S TURBINES.

It is reported that the Curtis turbines in the steamer Creole of the Morgan Line, are to be removed and replaced by reciprocating engines. The Creole has been laid up for some time and has, in fact, never been taken over by the Morgan Line from her builders, the Fore River Shipbuilding Co., of Quincy, Mass.

The reports regarding the ship have been numerous and varied, but this much is certain, that she has not fulfilled her contract requirements as to speed and fuel consumption. It is altogether probable that the Creole's troubles are in a great measure those referred to elsewhere in this issue, as common to turbine-driven ships. In all probability, the difference in combined efficiency of engine and propeller as between the reciprocating engines and turbines, was either overlooked or not sufficiently considered. It is not to be considered for a moment that this will in any sense affect the standing of the Curtis turbine as a marine motor within those limits where the turbine may be properly and profitably employed. The designed speed of the Creole, which is stated to be 16 knots, is in itself too low for the best results; in fact, it is doubtful if any design of turbine or propeller can make so good a showing at this speed as the reciprocating engine. Moreover, the Creole was the first installation of the Curtis marine turbine, which has since been installed in the scout cruiser Salem, and is being installed in the battleship North Dakota. The Salem did not make quite so good a showing as the Chester, which is fitted with Parsons turbines, but it was later discovered that the blading in the Salem had met with serious injury, and it is too soon to say that the results obtained are to be considered final.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.

The forthcoming summer convention of the society which is to be held at Detroit, June 25 and 26, promises to be a thoroughly enjoyable affair. The headquarters will be at the Hotel Pontchartrain, and the professional sessions will be held in the rooms of the Employers' Association in the Stevens building, at the corner of Grand river and Washington avenues. The number of papers to be presented will be few; in fact, the convention is intended more as an initial summer outing for the society; but it is to be hoped that it will become a permanent feature, and if the efforts of the committee on arrangements and the citizens of Detroit count for anything, it most probably will.

The first day, Thursday, June 24, the

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society will be called to order at 9:30 a. m., merely to get the proceedings under way, and will almost immediately adjourn to avail themselves of the invitation of the Detroit Ship Building Co. who have undertaken the entertainment of the society for the day and have engaged the steamer Britannia to convey the party to Wyandotte to witness the launch of the steamer Conemaugh for the Anchor Line. The side launch will doubtless be a novelty to most of the coast members. After the launch, a luncheon will be served on board the Britannia and the steamer will at once proceed down the river and give the party an opportunity to witness the work on the Livingstone channel, returning to the city towards evening.

The second day, Friday, a morning session will be held at the rooms in the Stevens building, at which papers will be read and discussed. In the afternoon the party will board the U. S. S. Don Juan d'Austria which has been very graciously placed at the disposal of the society for the day by the Michigan Naval Militia and which will convey the members, ladies and guests to the Old Club at St. Clair Flats, where dinner will be served, returning during the evening.

On Saturday a morning session will be held and the reading and discussion of papers concluded, and in the afternoon autos will be provided for trips about Belle Isle, Grosse Point, etc., with afternoon tea at the Country Club, concluding the proceedings of the convention.

Members and guests are urged to register at the registration office on the parlor floor of the Hotel Pontchartrain immediately on arrival. The final program will be distributed at the registration office. Visiting members who may wish to return via Cleveland will have an opportunity, through special arrangement with the D. & C. Navigation Co., of making the trip by the steamer City of Cleveland. It is much to be regretted that lake shipping will probably not be in a normal condition at the time and that probably not much over 60 per cent of the tonnage will be in commission, as an opportunity to judge of its volume would doubtless be enlightening to many of the visitors.

Boiler Explosion on Steamer Hoyt

ON THE morning of May 15 the starboard boiler of the steamer Jas. H. Hoyt exploded when the ship was about 3½ miles off Fairport, O., enroute to Ashtabula, killing three men and injuring three others, two seriously. Among those injured was the chief engineer, John Duggan. The Hoyt is a modern steel bulk freighter built by the American Ship Building Co. at Superior, Wis., in 1902, and is 356 ft. keel, 50 ft. beam, 27 ft. deep, and is fitted with triple expansion engines and Babcock & Wilcox water tube boilers of the "all large tube" type. The boilers are fitted with automatic traveling grate stokers and automatic feed water regulators. The killed and injured were taken ashore at Fairport and thence to Painesville for attention. An inquest was held at Painesville, and subsequently the inspectors of steam vessels, at Cleveland, preferred charges against the chief engineer and a trial was given him at Cleveland on May 22, before Capt. Jas. Stone, supervising inspector for the Ninth District, as a result of which he was exonerated of blame.

In the evidence given at the coroner's inquest, Chief Engineer Duggan testified that he knew nothing positively as to the cause of the explosion, nor had he observed anything unusual about the boilers previous to the explosion. He testified further that there was no explosion, "simply the letting go of the headers caused the escape of steam."

In his testimony before Supervising Inspector Stone, Duggan said that between the time of leaving Cleveland and the rupture of the boiler (about three hours), the gage cocks were tried at least six times per hour and the glass was blown down several times, not only by himself, but by the "handy man," and that a considerable time before the rupture took place he noticed an abnormal or unusual action of the water in the glass and immediately proceeded to draw the fires, but before this was completed the boiler gave way.

He also testified that the time elapsing between his noticing the peculiar behavior of the glass and the explosion was not over ten minutes. Immediately following the rupture it was discovered that the valve in the steam connection to the water column was closed, and as the testimony of the engine room crew was to the effect that none of them had closed it, it was sought to be shown that it must have been closed maliciously by some one on board. Only the chief engineer testified as to positive knowledge of its being open on leaving Cleveland.

Other testimony was to the effect that the boiler, as indicated by its appearance subsequent to the explosion, was empty or nearly so.

Independent of the apparently contradictory statements by the chief engineer before the coroner and Capt. Stone, it is not by any means difficult to arrive at a conclusion as to the probable facts. First, the evidence as to the change in water level from normal to that of an empty boiler in ten minutes may be set aside without consideration; the thing is impossible without water having some exit from the boiler, even if the valve had been closed by some one on board, and that this was the case is a wild improbability.

That the gage cocks were tested six times per hour is within the bounds of possibility, although also to be doubted, and the fact that that evidence is the unsupported statement of the chief engineer, is not to be overlooked. He also, by his own statement, had entire charge of the feed water that morning and it does not appear that any other of the engine room crew paid any attention to it. That the valve was found closed may be accepted as a fact and that it was never open at any time after leaving Cleveland is not only not impossible, but the probable truth.

How much feed water was admitted to the boiler during those three hours is, of course, problematical; there must have been some, because the entire water contents of the boiler probably did not exceed 10,000 pounds and even at the leisurely gait at which the Hoyt was traveling, not over 9 miles per hour, the evaporation from one boiler could hardly have been less than 10,000 pounds per hour, but the drum alone contained about 3,200 pounds to working level and this could not have disappeared in 10 minutes, as positively asserted by Duggan. The engine room crew simply deceived themselves, as is further evident from Duggan's statement that even when his glass and try-cocks were showing water, when he blew down the column proper he got dry steam. If the lower connection to the column was uncovered, how could the glass and try-cocks be repeatedly blown, as stated, and continue to show

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water at all, to say nothing of a working level? A water column is no mystery and has only one source of supply, and to say that a boiler may be short of water and the glass continue to show partly full in spite of repeated blowing, because the upper connection is closed and yet leaking just enough to prevent the water either dropping out altogether or showing a full glass, while it is charitable, that is the best that can be said of it.

The fact that they had been having trouble with a hot piston rod helps to acount for some of the conditions evidently existing at the time. There were evidently some features not brought out in the evidence.

It appears further from the evidence that there were no gage cocks attached directly to the boiler drum, as provided for by section 24, rule II of the regulations, or, if so, they were not used. If they had been, even occasionally, the condition resulting in the destruction of the boiler could not have existed. Why did this not receive the attention of the inspector?

The record of the water tube boiler in regard to loss of life aboard ship has certainly been unfortunate, even leaving out of consideration their relatively limited use.

Supervising Inspector Stone's Decision.

The finding of the supervising inspector in Duggan's case follows:

Steamboat Inspection Service, Office of Supervising Inspector, Cleveland, O., May 28, 1909.

On the morning of May 15, 1909, a verbal report came to this office through the agent of the Provident Steamship Co., which owned the steamer James H. Hoyt, that one of the boilers on said steamer had exploded while the ship was about 3½ miles from Fairport, O., resulting in the loss of three lives in the engineer department.

On Sunday morning (2:30) the ship returned to Cleveland, her port of departure. On May 18 the captain, chief engineer, mate, handy man, one fireman and one oiler were summoned to the office of the local inspectors of steam vessels, Cleveland, O., for a preliminary hearing which resulted in exonerating the master of the steamer James H. Hoyt from any violation of law in leaving port without an assistant engineer as section 4463, second and third paragraph, United States Revised Statutes, provides for such cases. Charges were preferred by this office against John Duggan, chief engineer, for negligence in allowing the water in starboard boiler to become so low that an overheated condition resulted in the rupture of the boiler with the above mentioned result.

The evidence given at the trial on May 22 shows that on May 15, 1909, the steamer James H. Hoyt left Cleveland, O., at 4:30 a. m., bound for Ashtabula, O., with a full crew, with the exception of an assistant engineer. An assistant engineer had arranged to join the steamer on her arrival at Ashtabula; when the steamer had arrived at a point about 30 miles east of Cleveland, near Fairport, the starboard boiler of the steamer became ruptured by several of the tubes pulling out of the headers, causing smoke, steam and ashes to fill the fire room and engineroom so suddenly, that all could not escape, causing the death of three men in the engineer department, and without further injury to steamer.

Cause of the Accident.

The cause of the accident was low water in the boiler, this fact was so testified to by John Duggan, the engineer in charge, and corroborated by three experts in their testimony, who examined the boiler the next day after the steamer returned to Cleveland, O. The evidence further shows that John Duggan, the engineer of the steamer, is 42 years old, is a thoroughly competent engineer, now holding his 12th issue of license, and had filled all positions in the engine department of steamers on the great lakes and ocean, also that there was no lack of attention paid to the gages and water glass.

On the steamer's departure from Cleveland the boiler as well as all things connected with that department were in good condition and working properly until for about 3½ hours, or about 30 miles from Cleveland, the engineer discovered the water gage on the starboard boiler did not appear to act properly, though showing water in the glass all the time, but the remarkably quiet condition of the water in the glass aroused his suspicion that something was radically wrong. Opening the lower valve in the glass, an air bubble appeared, which condition indicated to the engineer an absence of water; he immediately rushed into the fire room, ordered and assisted in drawing the fires from under the starboard boiler, then hurrying around performing various duties to prevent such disastrous results as might or might not occur, and just while returning to the boiler-room from the engineroom, the concussion came, hurling him across the engine room, severely burning his hands, arms and face, from which he soon recovered, and took the lead in trying to rescue those who were injured, and who were still in the fire hold, from which they were removed in varying conditions of injury.

Finding the Closed Valve.

Immediately after the accident, the engineer, the first mate, and an oiler went into the boiler room, the oiler ahead with a wrench applying the wrench to the valve in the water pipe leading to the water gage, found the valve open as it should be, then trying the valve in steam connection found it closed, causing inquiry as to how the water remained in the glass with very little or no steam in the drum.

Three expert engineers gave it as their unanimous opinion in their evidence at this trial that such conditions might exist for a short time, or possibly the valve might leak steam a very little sufficient to offset the condensation in the water glass, and thereby maintaining sufficient pressure to equalize the diminished force of low water in the lower part of drum and pipe. Said experts also testified that the steamer could not have run probably over an hour with this valve closed, without developing results out of the ordinary, which would attract the attention of the engineer.

The fact that all the evidence in the case shows that everything pertaining to the safety of the boilers, was in good condition when leaving Cleveland, and that within 3½ hours' time the boiler gave way, leads to the probability that the valve was closed by some one unknown.

From a personal examination of the upper part of the boiler-room, the spot where the valves were located, was found to be accessible at any time to any person on board without the knowledge of the engineer. The following facts being well known among engineers and firemen of experience and also among masters of steamers, and those having to do with boiler repairs, that probably not more than one case out of a hundred of injury to boilers from low water, are attended with disastrous results; therefore, the trifling per cent of damage from a condition of low water would probably not deter a viciously inclined person from tampering with the valve, and thus burning and injuring the boiler with no probable expectation of the injury extending beyond the interior of the boiler itself.

In view of all these facts as presented by the testimony in the case, I do not find sufficient evidence to sustain the charge of negligence preferred

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against John Duggan, engineer of the steamer James H. Hoyt. Therefore, the charge of negligence is not sustained, and the accused discharged.

(Signed) JAMES STONE,
United States Supervising
United States Supervising Inspector.
Acting for Local Inspectors of Steam Vessels.

EXPLOSION ON THE FOCA.

GASOLINE has much to commend it as a propulsive agent, but its searching qualities and its volatility cause its use to be fraught with some risks unless handled with a great amount of caution. The hazard would be materially reduced if the danger lay only in the presence of gasoline, per se, which would give visual indication of impending danger, but, on the contrary, the most perilous part of this fuel is its invisible, heavy fumes which have a way of settling into pocketed spaces and forming with the air a violent explosive mixture.

On April 26, an explosion of gasoline fumes aboard the Italian submersible Foca, resulted in the immediate killing of eight of the crew and the fatal injuring of a number of others. On May 12 an explosion of gasoline fumes occurred aboard the U. S. Submarine Cuttlefish. Fortunately there was no loss of life, and the extent of the damage and the circumstances of the accident are undergoing official investigation. Both mishaps, however, show that the use of heavy oils instead of gasoline would unquestionably give an added measure of security especially aboard submarine vessels where the ventilation is necessarily largely induced by mechanical means, and where the presence of electric motors and switchboards which are liable to spark, double the chances of danger.

Some Pregnant Suggestions.

The circumstances attending the disaster aboard the Foca are pregnant with suggestiveness and point to the part which atmospheric conditions may play in increasing the hazards associated with the use of gasoline aboard submarine vessels. At the time of the explosion, the Foca was lying within the military harbor of Naples, and her crew were engaged in completing the replenishment of her fuel supply—in fact, her gasoline tanks had actually been filled. The day was hot and humid and there was not a breath of air stirring. In this absolute calm, the petrol fumes hung about the boat and found their way into the superstructures—the manholes in which had been opened to facilitate making connections with the leads to the fuel tanks. In this manner, the heavy gasoline gas flowed into the superstructure space and remained there by reason of its weight and the fact that no effort was made to permit them again to flow outboard. All that was necessary to create a disaster was an igniting spark, and this appeared in due season. It makes no difference whether this spark came from the smokestack of a near-by vessel or whether from the pipe or cigarette of a heedless smoker—the result is the only thing of present moment.

Freeing Ports Should be Open.

It is the usual custom aboard submarine boats to close all hatches leading into the vessel when gasoline is being taken on board in order that the fumes may not follow their natural flow downward and find their way into the body of the boat. It would seem that this precaution was, in fact, taken in the case of the Foca, but the commanding officer failed to recognize that the superstructure space, in itself, formed a dangerous counterpart of his main hull so long as it became a pocket for the reception and the retention of the explosive gas. In the Foca and the later submersibles of the Laurenti type, the superstructure is designed to be self-bailing when running in a seaway or when the vessel rises from a submergence—the water flowing outboard by gravity through freeing ports at the lower sides of the superstructure. Had these freeing ports been open—as they should have been—at the time the boat was taking petrol aboard—the fumes flowing into the superstructure through the deck openings would have passed outboard by reason of their own weight and gravity through the lower freeing ports, and there would have been no dangerous accumulation of gas within that space. The mechanical or structural safeguards were present, but the officer of the Royal Marine in charge failed to take advantage of them. Just why they should have been closed at all is not plain, unless the boat during her sea run met with exceptionally heavy weather, and it was deemed expedient to close these freeing ports in order to add that much more to the vessel's reserve of buoyancy. This explanation, however, does not seem to have point, because the Foca made an exceptionaally rapid run from Spezia to Naples—covering the intervening distance of 400 miles in the remarkably quick time of 35 hours of continuous steaming. During the nighttime, the Foca ran under her middle screw making about 10 knots an hour, and during daylight she used all three screws and attained an hourly speed of quite 14 knots. She could not have done this had she encountered heavy weather.

Building in the United States.

Apart from this accident with its significant lesson, the Foca is of interest to us because a vessel of this type but of larger dimensions is under construction at the ship yard of William Cramp & Sons for the United States navy. It should be a source of satisfaction, therefore, to us to know that there is nothing defective in the design of this particular type of submersible, and that the exercise of reasonable foresight and the proper availment of the features provided will prevent a similar recurrence here.

Since the Foca has been raised, it has been found that the direct violence of the explosion was localized in shattering the boat's light superstructure—the main hull lying below and built to withstand the pressures due to submergence being intact and unaffected by the explosion. Apart from this, the gasoline tanks were found filled with fuel and likewise undisturbed by the explosion. Had the gasoline fumes accumulated within the main body of the boat and there been ignited, the result would have been far more disastrous to the boat, itself, and the mishap shows how thoroughly the Foca was protected against this danger. The official board of inquiry found the engines and internal mechanisms unimpared save for the damage naturally to be expected through the inflow of salt water, and in this direction the most of the damage was done to the storage batteries. Had a breeze been blowing at the time it is quite likely the fumes would have been rapidly dissipated to leeward, and we can now appreciate that atmospheric conditions involving high temperature, humidity, and a calm provide potential dangers in themselves when gasoline is being carried into a vessel—especially if that vessel is low lying and deep draughted as are boats for submarine service. The accident teaches us one more important lesson which will not be lost upon our experts.

C. M. Heald, general manager of the Mutual Transit Co. of Buffalo has given an order to the Great Lakes Engineering Works for a package freighter to be a duplicate of the North Lake and North Sea and to come out in 1910.

The steamer William E. Corey of the Pittsburg Steamship Co.'s fleet, discharged 9,300 tons of ore at Ashtabula Saturday, May 16, in 4 hours and 34 minutes.

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The Vibrations of Ships

And the Use of a Dynamical Model for Determining the Elasticity of Ships[1]

By Prof. J. B. Henderson, D.Sc.

Part I.

The Elasticity of Ships as Deduced from Experiments on the Vibration of Dynamical Models.

THE experiments recorded in the following pages form part of some experiments on vibrations of elastic structures carried out during sessions 1906-7 and 1907-8 in the Engineering Laboratory of the Royal Naval College, Greenwich, by some of the third year students.

The first set of experiments was undertaken with the view of verifying the theory of the vibration of uniform rods. A steel straight edge of rectangular section 36.1 in. × 3.0 in. × 0.45 in. weighing 14 lbs. was supported at two nodes and vibrated electromagnetically, as shown diagrammatically in Fig. 1. The electromagnets were placed alternately above and below the bar, and therefore forced it to vibrate in a definite mode; and the current to the magnets was "made" and "broken" by the vibration of the bar itself, just as in an electric bell. The frequency of vibration of the bar was measured

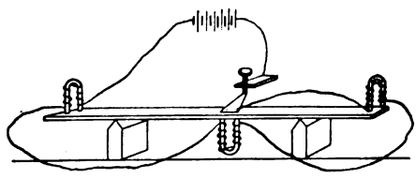

FIG. 1.

stroboscopically, and, although several arrangements of stroboscope were used, only the final one will be described. It has the great advantage over the others that the experimenter sees at once whether the stroboscopic disc is going too fast or too slow for synchronism, and can adjust accordingly—thereby ensuring a very high order of accuracy in determining the frequency. Fig. 2 shows the arrangement. The short-focus lens L, which is fixed to the vibrating bar B, forms a small image of the stroboscopic disc in front of the objective of the low-powered microscope M. The microscope is focussed on the image of the top or bottom edge of the slots in the disc. The stroboscopic disc is driven by a direct current motor, and the speed of the motor is measured by a revolution counter mounted directly on the spindle. With this arrangement of stroboscope, when the disc is rotating at synchronous speed, i. e., one slot crossing the field of view in one period of the bar's vibration, the experimenter, on looking through the microscope, sees the edge of a disc whose periphery has a wavy form. If the speed of the disc is double the synchronous speed, then one sees two such discs superposed with the edge differing in phase by half a wave length, and so on. Of course, it is necessary to exclude all direct illumination from the image of the disc. If the speed is slightly above or below synchronism, the waves appear to move to right or left, according as the speed deviation is in one direction or the other, and the experimenter has no difficulty in maintaining the same wave continuously in the field of view for five minutes at a time, if he has at his command a sufficiently fine adjustment on the speed of the motor.

Experiments were carried out with the bar vibrating in its fundamental mode, and in its first, second, and third harmonics, with 2, 3, 4 and 5 nodes respectively in the length. The positions of the nodes were obtained by scattering sand on the upper surface, and the two supports were always placed so as to coincide with two nodes.

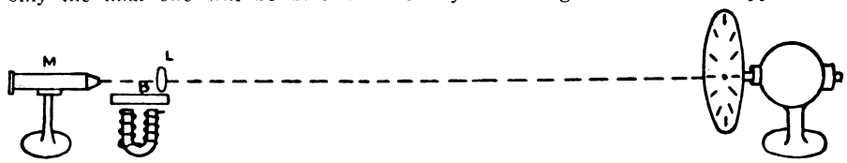

FIG. 2.

The results of the experiments are given in the following table, which shows also a comparison between theory and experiment.

[1]Read at the spring meetings of the Institution of Naval Architects, March 31, 1909.

Vibrations of Ships.

The vibrations of the uniform bar having shown satisfactory agreement between theory and experiment, and the apparatus being ready for the study of the vibrations of any elastic structure, it was decided to obtain the periods of vibration of a ship by means of her dynamic model, as was done by Mr. A. Mallock. By a dynamic model is meant a beam or girder which has a load curve similar to the load curve of the ship, and a curve of moments of inertia of sections about the neutral axes similar to the corresponding curve for the ship. The scale for the load curve does not require to be the same as the scale for the moment of inertia curve.

	Frequency of vibration. Complete periods per second.		Distance of nodes from nearer end, measured in fractions of the length.	
No. of nodes.	Experiment.	Theory.	Experiment.	Theory.
2	72.25	72.3	0.224	0.2242
3	200	201	0.130, 0.5	0.1321, 0.5
4	394	394	0.094, 0.358	0.0944, 0.3558
5	649	651	0.073, 0.277, 0.5	0.0735, 0.277, 0.5

The period of vibration of a beam will depend on the stiffness of the beam in bending, on the mass of unit length, and on the length of the beam.

Hence, if we know the periods of both ship and model, we can deduce the elastic properties of the ship; or, we can calculate the period of the ship from that of the model.

H. M. S. Pathfinder was chosen, for which the curve of weights had been worked out with great accuracy and for which the curve of moments of inertia of a number of different sections had also been calculated. She is a scout of about 3,000 tons displacement. The condition of lading corresponded to the bunkers being about half full of coal.

A dynamic model of the ship was made from a bar of steel of uniform thickness, 48 in. long, ¾ in. thick, the breadth being varied so as to give the correct relative moment of inertia for every section. Since the moment of inertia of the section is simply propor-

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tional to the breadth, it is sufficient to make the breadth directly proportional to the ordinates of the moment of inertia curve, in order to have the beam to scale as regards the stiffness. The scale of loads is then fixed by the section which has minimum ratio of load to moment of inertia, since at this section we want the weight of the bar itself to represent the load, and at all other sections we can add lead weights to bring up the mass of unit length to the corresponding amount on the ship. Thirty lead weights were necessary to bring the loads to correspond with the load curve of the ship, and these were soldered to the bar. It was anticipated that soldering these masses of lead over a considerable portion of the length of the bar would stiffen it considerably; but experiments made with the lead continuous, and also with it cut up into very short lengths, showed no marked alteration in the period of vibration. Hence the lead cannot contribute to the stiffness to any appreciable extent.

The scale of weights was found by weighing the finished model, and the position of the center of gravity of the model was found to be less than 0.25 per cent of the length of the model from the correct position as calculated in the ship.

In order to force the bar to vibrate by means of electro-magnets placed alternately above and below the bar, the lead weights had to be soldered at some parts of the length above the bar, and at other parts below it, so that the magnetic pull might come directly on the bar with as small an air gap as possible, and with no lead between the magnets and the bar. Sufficient vibration was always obtainable to determine the nodes, whether the supports were near or far from them; but, in the determination of the frequency, the supports were always moved so as to coincide with two nodes.

Experiments were carried out with the model vibrating with two and also with three nodes in the length, and the results are given in the following table:

VIBRATION OF THE DYNAMIC MODEL OF H. M. S. PATHFINDER.

No. of nodes.	Frequency—Complete periods per second.	Positions of nodes in fractions of the length from the bow.
2	81.8	0.280, 0.728
3	194	0.179, 0.515, 0.832

The frequency of the model with three nodes is 19 per cent greater than double the frequency with two nodes, but 14½ per cent less than it would be if the periods followed the same law as in the uniform bar.

If the modulus of elasticity of the ship were equal to the modulus of the bar, the scales of the ship and model are such that the frequency of the ship would be 127 per minute. Unfortunately no pallograph records are available for this ship, but I am indebted to the Admiralty and to the officers of the ship for carrying out some experiments on her vertical vibrations. They report that the frequency of vertical vibration is 106 per minute when the engines are running at 100 R. P. M. Hence the modulus of the ship must be less than that of the model in the ratio:

$$\left(\frac{106}{127}\right)^2 = 0.70$$

i. e., 30 per cent lower.

Vibration of Turbine Steamer.

The first set of experiments having been carried out on the model of a gun-boat, it seemed desirable to repeat the experiments with another type of ship, and preferably with one whose period of vibration had been accurately determined. The writer is very much indebted to Messrs. John Brown & Co., and the joint managing directors, Messrs. Chas. E. Ellis and J. G. Dunlop, for the data regarding the turbine steamer Lusitania which enabled her model to be constructed, and also for the pallograph records of her vibrations at sea. The dynamical model was made 48 in. long, ¼ in. thick, and with a maximum breadth 5.1 in.

The results of the experiments are as follows:

VIBRATIONS OF MODEL OF TURBINE STEAMER.

No. of nodes.	Frequency periods per second.	Positions of nodes from bow in fractions of the length.
2	72.55	0.26, 0.76
3	182	0.153, 0.53, 0.853
4	350	

The frequency of the model, according to the scales chosen, should be 58.4 times the frequency of the ship. Hence for equal moduli the fundamental frequency of the ship should be:

$$\frac{72.5}{58.4} = \frac{1.244}{\text{sec.}} = \frac{74.6}{\text{min.}}$$

The actual frequency of the ship is 65 per minute; hence the ratio of the elasticity of the ship to that of the model is:

$$\left(\frac{65}{74.6}\right)^2 = 0.761,$$

or the elasticity of the ship is 24 per cent less than that of the model.

This is greater than was obtained for the Pathfinder, but the plating in the scout is very much thinner than that in the liner. Thin plates are, as a rule, more buckled than thick plates; and, since the buckles straighten out when a pull stress comes on them, the thin plates must give a lower modulus in vibration than the thick plates, because, when a plate straightens under pull stress, it is equivalent to an increase of strain for the same stress.

An objection may be raised against the comparison of ship and model in that the model vibrates freely in air, while the ship vibrates in water, and has its vibration considerably damped. We are dealing, however, with the forced vibrations of the ship, due to a periodically applied force arising from rotation of the screws or other machinery on board, and such forced vibrations, when damped, always reach their maximum amplitude if the periodicity of the exciting disturbance agrees with the natural free period of the vibrating structure. In ships the amplitude of vibration is, as a rule, negligible, unless there is approximate equality in the period.

In addition to its damping effect on the vibrations the water has another effect, especially when the period of vibration is very slow, for then the water will move in stream-line motion backwards and forwards along the bottom past the nodes, as one portion of the ship rises and the neighboring portion sinks. The more rapid the vibration the less must this effect be. Experiments show that the virtual mass of a body rotating in a fluid is very much less than the virtual mass of the same body moving through the fluid, and we would anticipate that the virtual mass in vibration would be still less than in rotation. It is important to remember that this effect is present, although of small magnitude, and that it would probably have no greater influence than the quantities which are neglected or allowed for roughly in the calculation of the moments of inertia of the ship.

In calculating the moments of inertia the practice is to neglect the wooden decks or sometimes to add 1-25 of their thickness to the steel decks below them. This was done in the case of the Pathfinder. In strength calculations the wood of the deck would only contribute to the strength of the ship in sagging, and not in hogging; but in vibration it would always contribute to the stiffness, since the fastening between wooden and steel decks is quite sufficiently strong to take the small shear stresses introduced by the vibration. It is also customary to neglect the intercostal girders in calculating the moments of inertia. These girders may not contribute much strength to the weakest sections of the ship, but they certainly contribute to the stiffness of the ship as an elastic structure.

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Part II.

The Causes of Vibration in Ships and Their Location by Means of Pallograph Records.

A pallograph record of the vibrations of any ship gives us information regarding the natural periods of vibration of the ship and the frequencies of revolution of the screws; but it is, as a rule, difficult to locate the exciting cause of the vibration, unless there happens to be some simple relation between the frequency of a screw and the natural frequency of the ship. This will, however, rarely happen, and the exciting cause can only be located by a process of deductive reasoning from our knowledge of all the exciting causes which may be present. Every portion of an elastic structure may vibrate with a natural period of its own, if there is a local exciting impulse of about the same frequency; but these local tremors may sometimes be the exciting cause of the ship's vibration, if the periods of the two should happen to agree.

A stretched string, as in a violin or pianoforte, will vibrate in unison with a tuning fork of the same frequency sounded in its neighborhood. It will also vibrate in unison with a tuning fork of double, treble, or n times that frequency, the string then having 1, 2, 3 or n nodes in its length. A bar, however, while it will vibrate in unison with a tuning fork having the same frequency as the bar, will not vibrate *in unison* with tuning forks having the harmonic frequencies. The reason for this lies in the fact that the frequencies of vibration of a string in its different modes are in the simple ratios 1, 2, 3...n, while those of a uniform free bar are approximately in the ratios of the squares of the odd numbers, 3^2, 5^2, 7^2, etc. The frequencies of vibration of a structure such as a ship in its different modes cannot possibly follow a simple rule, and cannot be calculated; but the vibrations having been excited in the ship and recorded on the pallograph, it lies with us to analyze all the exciting impulses, and to find out which of these has a harmonic having the same frequency as the vibration.

The idea of analyzing an impulse may be new to some. If a periodic impulse is due to, say, a rotating crankshaft out of balance, it is of sine form, and has no harmonics; but if the periodic impulse is of the hammer-blow type, it is very rich in harmonics, and can, by Fourier's analysis, be analyzed into a series of sine impulses whose frequencies are in the ratios 1, 2, 3...n. Thus a periodic hammer blow is equivalent to a series of shafts out of balance revolving at frequencies 1, 2, ..n times the frequency of the hammer blow. It is evident, then, that, although the frequency of the blow may not agree with the natural frequency of the ship, the frequency of one of the harmonics may agree with it.

Various Periodic Impulses.

The various periodic impulses which are applied to a ship may be summarized as follows: (1) Inertia forces due to reciprocating masses in the main engines or auxiliaries. (2) Inertia forces due to want of balance in the rotating masses. (3) Longitudinal or transverse vibration of any portion of the ship's structure due to a local exciting cause, such as the longitudinal vibration of the mast when used for a boat hoist or derrick, the whirling of a shaft, etc. (4) The reactions on the ship corresponding to the periodic pulsations of speed in the crank shaft. (5) Insufficient clearance between the blades of the screw and the ship's side or **A** bracket, so that the flow of water to the blade nearest the ship is restricted, and the torque thereby reduced. The torque is then unsymmetrically applied to the propeller, with the result that there is a reaction on the propeller bracket or stern tube. In the case of a single screw, this reaction would be in the horizontal plane, and would tend to excite horizontal vibrations; but in the case of multiple screws the reaction would generally be in a plane inclined to the vertical, and would tend to excite both horizontal and vertical vibrations. (This reaction, if due to horizontal "spectacle" brackets would be vertical.) (6) With multiple screws running at different speeds, the fundamentals or harmonics in the impulses under heading (5) will periodically "beat," corresponding to the beats in music when two notes, slightly out of tune, are sounded together. These beats may give rise to low-frequency vibrations. Sea-waves.

The vibrations due to rotating or reciprocating masses out of balance would, as a rule, be easily recognizable by the agreement of the periods. The impulses to which such masses give rise will be almost simple harmonic in character, and will be of the frequency of revolution, or double that frequency in the case of the inertia reactions of the connecting rods. The impulses under heading (4) could be obtained by an analysis of the crank-effort diagram, and it may be noted in carrying out such an analysis that any impulse which is symmetrically positive and negative when plotted as a function of time can have no even harmonics. The graphic method of analysis is very easily carried out.

Natural Period of Vibration.

Under heading (3) will fall all vibrations due to the natural vibration of the tail shaft. We have seen that this shaft is subjected to periodic pulsations every time a propeller blade passes close to the ship; hence, if this frequency corresponds with the frequency of lateral vibrations of the tail shaft loaded with the propeller, the shaft will vibrate very considerably. The natural period of vibration of the loaded shaft is its period of whirling, which is easily calculated. Hence a shaft with a three-bladed propeller will vibrate considerably when revolving at one-third of its whirling speed, and with a four-bladed propeller at one-fourth of its whirling speed. In analyzing vibrations it will, therefore, be advisable to calculate the whirling speeds of the tail shafts. Under heading (4) we should also have to consider the natural period of vibration of each bracket loaded as it is with the propeller and a portion of the tail shaft. Since it is subjected to the same periodic pulsations as the propeller, it will vibrate considerably if these pulsations correspond with its own natural frequency. There may be other portions of the structure round the stern which are also capable of vibrating in unison with these impulses, but the calculation of their natural periods would not be easy.

Let us now apply these considerations to an actual case. The writer is indebted to W. J. Luke for a pallograph record of the Lusitania. The record shows intermittent vibrations of small amplitude both of low and high frequencies, but during one experiment while the ship was turning, the low frequency vibration was of considerable amplitude, and was well sustained for over a minute. A portion of this record is reproduced in Fig. 3. There must have been during that interval of time a periodic pulsation corresponding with the fundamental frequency of the ship's structure. This pulsation could only arise from the propellers, since the ship is turbine driven. Careful measurement of the pallograph record gives the following data:

FREQUENCY OF VERTICAL VIBRATION OF SHIP = 64.1 PER MINUTE.

	Revolutions per minute.	Frequency of propeller blade impulses.
Propeller No. (1).....	145.5	436.5
Propeller No. (2).....	161.2	483.6
Propeller No. (3).....	143	429
Propeller No. (4).....	152.2	456.6

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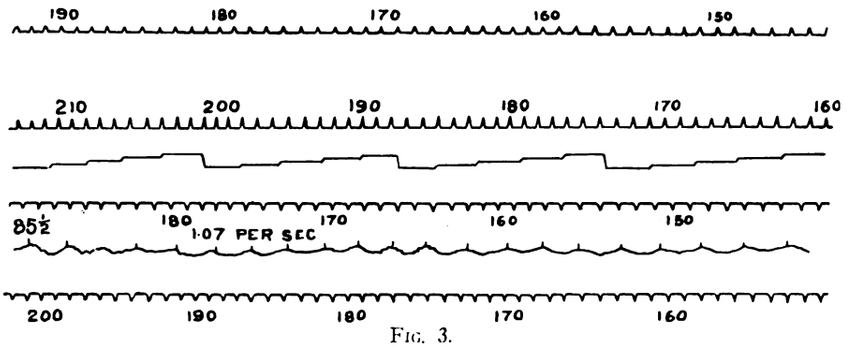

FIG. 3.

The frequency of propeller blade impulse is about seven times the frequency we are looking for, and if it were exactly seven times we might conclude that we had located the cause, because any impulse whose frequency is an odd harmonic of the natural frequency of the bar will excite the fundamental vibrations in the bar. For, if we consider the fundamental and, say, the third harmonic, their relationship is shown in Fig. 3; and it will be noticed that, during each half period of the fundamental, there is an odd impulse in the third harmonic, and these odd impulses, being alternately positive and negative, are just so timed as to excite the fundamental vibration. Of course, if the bar could vibrate in unison with this third harmonic impulse, it would do so; but, since it cannot, it vibrates in its fundamental mode. Any even harmonic impulse has the same number of positive and negative impulses in each half period of the fundamental, and it cannot, therefore, excite the fundamental vibration.

We see that the agreement between the fundamental propeller impulse and the seventh harmonic of the vibration frequency is not sufficiently close to account for the large amplitude of vibration, therefore we must look elsewhere for the cause. Let us examine the "beats" between the impulses of the four screws.

The bottom line of the table contains the frequency of the odd harmonics of the vibration frequency, and any impulse having the same frequency as one of these harmonics will help to excite the fundamental vibration in question. Let us compare these numbers with those in the table above them. We find no absolute agreement, but we find several which are sufficiently close to account for a vibration lasting, say, a quarter of a minute. Thus we have:

64 and 60 beating 4 times per minute.
192 and 188 beating 4 times per minute.
192 and 189 beating 3 times per minute.
192 and 193 beating 1 time per minute.

It is probably the last two which are the predominant factors in exciting the vibrations, namely the seventh harmonics in the propeller impulses of screws 2, 3 and 4.

FREQUENCY OF BEATS BETWEEN THE VARIOUS HARMONICS OF THE PROPELLER IMPULSES.

Propellers.	(Fundamental.)	Harmonics. 2	3	4	5	6	7
1 and 2.....	47.1	94.2	141	188	235	283	330
1 and 3.....	7.5	15	22	30	37	45	52
1 and 4.....	20.1	40.2	60	80	100	120	141
2 and 3.....	54.6	109.2	165	218	273	327	382
2 and 4.....	27	54	81	108	135	162	189
3 and 4.....	27.6	55	83	110	138	165	193
Frequency of the odd harmonics of the vibration	64.1	—	192	—	320	—	449

Almost every part of the pallograph record shows intermittent vertical vibrations of a much higher frequency and of small amplitude. Selecting a portion of the record where they lasted for five seconds, we find 41.5 periods in five seconds, i. e., a frequency of 8.3 per second, or 498 per minute. The corresponding frequencies of revolution of the screws, were:

	Revolutions per minute.	Frequency of propeller blade impulses.
Propeller 1.....	167	501
Propeller 2.....	164	492
Propeller 3.....	158	574
Propeller 4.....	166	498

It is evident that this vibration is directly due to the propeller impulses, since the frequencies agree, and the intermittent character of the vibration must be due to the interference of the impulses from the four screws. If all four screws rotated in the same phase and at the same speed, this vibration would be greatly magnified. At certain times they will rotate in the same phase, and then the vibration will be a maximum, but this cannot last for more than a few seconds unless the speeds of revolutions are all equal. That these are forced vibrations is evident from the fact that they occur with the same frequency in the record of horizontal vibrations. This record shows these vibrations very angular in character, such as we would expect in forced vibrations, and the approximate sine form of the corresponding vertical vibrations may be accounted for by the frequency agreeing more closely with one of the natural frequencies of vertical vibration than with one of the horizontal frequencies. By varying the speed of the screws these natural frequencies could all be obtained.

In one of the Mauretania's pallograph records which the writer has examined, there is a very pronounced intermittent vibration in both the vertical and horizontal planes, of frequency 9.7 per second, or 582 per minute. The screws were running at 193, 194, 193.2 and 194.5 revolutions per minute, and the frequencies of blade impulses were 579, 582, 579.6 and 583.5, so that these vibrations are undoubtedly forced vibrations due to the propeller impulses.

The same record shows intermittently a low frequency horizontal vibration of 6 periods in 4.25 seconds, or 84 per minute, lasting for 10 or 15 seconds at a time. From its sine form we conclude that it is a natural period of horizontal vibration of the ship. If, as in the Lusitania, we try the beats, we see that the highest frequency of beats in the fundamental is only 4.5 per minute, hence we should have to go to the 18th harmonic to get a frequency of 84. We must therefore look elsewhere for the exciting cause. It will be noticed that the seventh harmonic of the vibration would have a frequency of 588 per minute, which is very near the frequency of the propeller blade impulse, and so we have here a case of a periodic impulse exciting vibrations of one-seventh the frequency.

We have thus accounted satisfactorily for all the vibrations of any magnitude which are measurable on the pallograph records of these two ships. The intermittent absence of vibration in this or any other screw steamer must not be attributed to the absence of periodic impulses, but simply to the interference of the periodic disturbances due to the several screws.

Lieut. Col. Graham D. Fitch believes that the plans for the improvement of Marquette harbor would be modified advantageously by extending the breakwater in a southeasterly direction from the end of the present breakwater instead of extending it directly southward. This would facilitate the entrance of vessels in heavy weather and lessen the danger of their being thrown on the beach. The estimated cost of the improvement is $303,000.

The steamer Rube Richards, which sunk three years ago in Sarnia Bay, has been given by the Canadian government to the Bay City Wrecking Co., Bay City, Mich., for removing. She has been raised.

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A Take-Off on Technical Papers

THE subjoined letters taken from *The Engineer*, London, will doubtless be read with much amusement by members of technical societies everywhere. Certainly W. Standish has sent his thrusts home with a skill worthy of Dickens. His humor is rich and his satire none the less effective because it is gentle. Anyone who has sat through the labored reading of a ponderous paper a quarter of an inch thick, illustrated with numerous diagrams, can appreciate the merriment of his take-off, even if he does burlesque a little bit. Not for many, many months have the sober columns of *The Engineer* been enlivened by such a lively wit. Moreover, his moral is clear. Herewith is given an abstract of the first letter as published in *The Engineer*, and the letter of Standish which it called forth:

Gentlemen: You have sent me a copy of Mr. ——'s paper and asked me to take part in the discussion. My reply is, "There is nothing to discuss." You tell me that the paper is a quarter of an inch thick, would take the secretary over two hours to read, has a dozen plates, numerous diagrams in the text, and is illustrated by many samples and specimens. Your statements may be perfectly correct, but the fact remains that there is nothing in it to discuss.

Your author, I take it, has either no opinions of his own or he is so timid for his reputation that he dare not put them to the touch. He quotes well from other people, he describes at considerable length numerous interesting machines, and he records experiments of his own, or tests made for him by unchallengeable authorities. But he never, from one cover of his book—paper is misnomer for such a magnificent production—to the other cover, advances a single statement that will cause flutterings in the hearts of his audience and bring even one of them impulsively to his feet when the signal is given.

* * * * * * * *

And for your papers, gentlemen. Let me implore you to have them written with a view to discussion. Have them short and pithy, and put descriptions, if descriptions you must have, in appendices. But let the text deal with broad facts and principles that the mind can grasp, and on which it can form rapid conclusions. Encourage your authors to risk something or find authors who are prepared to do so.

Debatable subjects are to be found. "Plenty of subjects going about," said Uncle Pumblechook in a very similar connection, "for them that know how to put salt upon their tails. That's what's wanted. A man needn't go far to find his subject if he's ready with his salt-box."

Get a fighting Irishman or two into your midst. Some one who will trail his coat and dare you to tread on it; and when you have got him nourish and encourage him. Wave red rags before the bulls of your company. The greatest political truths and the greatest political events have been hammered out, forged, and wrought to perfection by debate, strong, nervous debate, carried on with decency that convention preserves if you will, but, still, as unlike your debates as a hawk is unlike a hacksaw.

Gentlemen, I return to you Mr. ——'s paper with the suggestion that you should get some one to write you something that could be discussed; and, with apologies for this letter, which is inspired by the sincerest regard for your ancient Institution, I ask permission to remain,

A SILENT MEMBER.

Sir: The following particulars of a paper and discussions, which I heard in the latter part of last year, will, perhaps, interest some of your readers taking part in the correspondence now going on in your columns. I went to the meeting at the invitation of a friend.

You will remember, no doubt, the establishment about nine years ago of the Institution of Universal Engineers, intended mainly to consist of men in the drawing office, managers and foremen. The idea was that their desire for a higher measure of education might be stimulated. There are, I understand, now about 600 members and associates.

The title of the paper was "An Inquiry Into the Asymptotic Influence of the Kinetic Integrated Development of Erasmic Polar Curves Raised to the *n*-th on the Efficiency of the Blades of High-Pressure Turbines," by Prof. Ebenezer Emilius Saxifrage, D.Sc., of Julius college, Lomanshire. There was a very good attendance, and there were eight members of council present.

The president, after some usual routine business, expressed his regret that Prof. Saxifrage was unable to be present, but the secretary would now read the paper.

It consisted of 52 pages of close print bristling with formulas, and seven sheets of diagrams. The secretary spent about an hour in picking out bits of text which he read and then sat down.

The president said that he felt that the society was to be heartily congratulated on receiving such an extremely valuable paper from a man in so distinguished a position as Prof. Saxifrage's, and he called upon the audience to accord the author, with acclamation, a special vote of thanks. This was given with tumultuous applause. The president then said that the meeting was open for discussion.

I did not notice that there was any alacrity manifested by members in availing themselves of the president's invitation. After a pause, however, a member stood up in the body of the hall, and was about to speak when the president interfered and requested him to come to the platform. The member said it was unnecessary, as he only wanted to ask a question. After some wrangling, however, he went to the platform, and then said that he only wished to ask some one to tell him whether the discussion was likely to be over before the last train went. No one seemed to know, so he got off the platform, took his hat and went away.

Another speaker then rose and said that he felt certain that a more valuable paper could not possibly be written, and for his own part he thanked Prof. Saxifrage for it from the bottom of his heart. He felt that where all was so good it might seem hypercritical, but it seemed to him that the printer had misplaced a bracket on pages 7 and 8. At all events, there was an expression there, and he found one bracket on page seven near the top and another on page eight near the bottom. Assuming that the printer had not made a mistake he ventured to say with some diffidence that a bracketed quantity which occupied two pages might perhaps be considered unwieldy. This was, however, only a matter of opinion. He would not occupy any more of the time of the meeting, but before sitting down he must again express his gratitude to the writer.

The next speaker, a highly enthusiastic young man of large dimensions, wearing huge gold spectacles, said that he was in a position to say that if the meeting could realize the zeal with which Prof. Saxifrage had thrown himself into the turbine question they would have been more than ever cordial in the expression of their gratitude. He was proud to say that he had had an interview two or three days before with the professor. He would scarcely be believed, but it was none the less a fact that the professor had assured him that when the paper was written he—the professor—had no idea whatever of what was inside a turbine casing. He appeared to think that the blades were used to cut the steam up into chunks. Busy man as the professor was, he contrived to spend nearly ten minutes in the speaker's works examining the inside of a turbine, and asking questions, the answers to which he did not appear at the moment to understand, but he took them down in his notebook and would no doubt use them further on. No doubt the ignorance of the professor might not appear at first sight to add to the value of the paper; but it had already been pointed out by one very eminent mathematician that the man who attacked a problem with an open ignorant mind was much more likely to reach a satisfactory solution than a man saturated with that prejudice which invariably resulted from an intimate acquaintance with actual facts.

When he sat down, a young man—evidently a student—rose. He said he wanted to ask a question, and, to save time, he proceeded to walk to the platform. He took his hat and umbrella with him and a bundle of papers. At last he reached the platform and began, "Mr. President and gentlemen." He then referred to voluminous notes, which he held in his left hand. After turning them over for an interminable time and dropping his glasses, he said he was afraid he had left the note he wanted on his seat, and was going back for it when his neighbor picked it up and it was passed from hand to hand to him. He only glanced at it, and without further preface, he said: "The question I have to ask is simply what is this paper about? I have not the least idea. I see a very full meeting of the council, however, and as they have read the paper and accepted it, they can, no doubt, either collectively or individually, tell me what the *n*-th of an Erasmic polar curve is, and what use can be made of it in designing turbine blades?"

A faint attempt at applause was promptly checked. The president then said that as no one else wished to speak, he would close the discussion. He had to apologize in some measure for the paper which was to be read at their next meeting, but it had been set up for some time, and the printer wanted the type. It was by no means of the value or importance of the paper which they had just had the good fortune to hear, being indeed only a short account of experiments made on a new kind of belting, which is a compound of fine steel wire and paper. It could not pretend to possess more than a practical interest. The members would find, as usual, tea, coffee and cigarettes in the tea room.

I have had, of course, to condense my report, but I have accurately enough given the

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sense of what took place during a meeting which lasted from 8 o'clock to 10 p. m. Every one seemed quite satisfied.

W. STANDISH.

April 12.

POWERFUL SUCTION DREDGERS.

The suction dredge Jinga, and her sister Kalu, built by William Simons & Co., Renfrew, for Bombay service, are fitted with one of the most powerful pumping plants afloat, capable of dredging 2,700 tons of material per hour, and discharging the spoil through a floating pipe line, and through land pipes, to a distance of upwards of 4,500 ft. from the side of the dredger. It is estimated that by the operations of these two dredgers, under the present scheme alone, an addition of 4½ per cent will be made to the area of the city of Bombay. The Kalu, it may be stated, is the seventh dredging vessel which Messrs. Simons have constructed for the Bombay Port Trust.

The pumping plant of each dredger consists of very large centrifugal suction and discharging pumps, directly coupled to triple-expansion surface-condensing engines. A large condenser is fitted to take the exhaust steam from all engines on board. The Jinga and her sister were arranged to proceed to Bombay under their own steam, and for this purpose they were fitted with two sets of compound surface-condensing engines, capable of giving the vessels a speed of eight knots. Steam is supplied from four very large cylindrical multitubular boilers, constructed to Lloyds' full requirements and fitted with Howden's patented force draught. The boilers are specially designed for burning inferior Indian coal. A very full equipment of engine room auxiliaries is provided, including independent circulation pumps, automatic feed pumps, bilge and general service pumps, feed heater, filter, evaporator, etc.

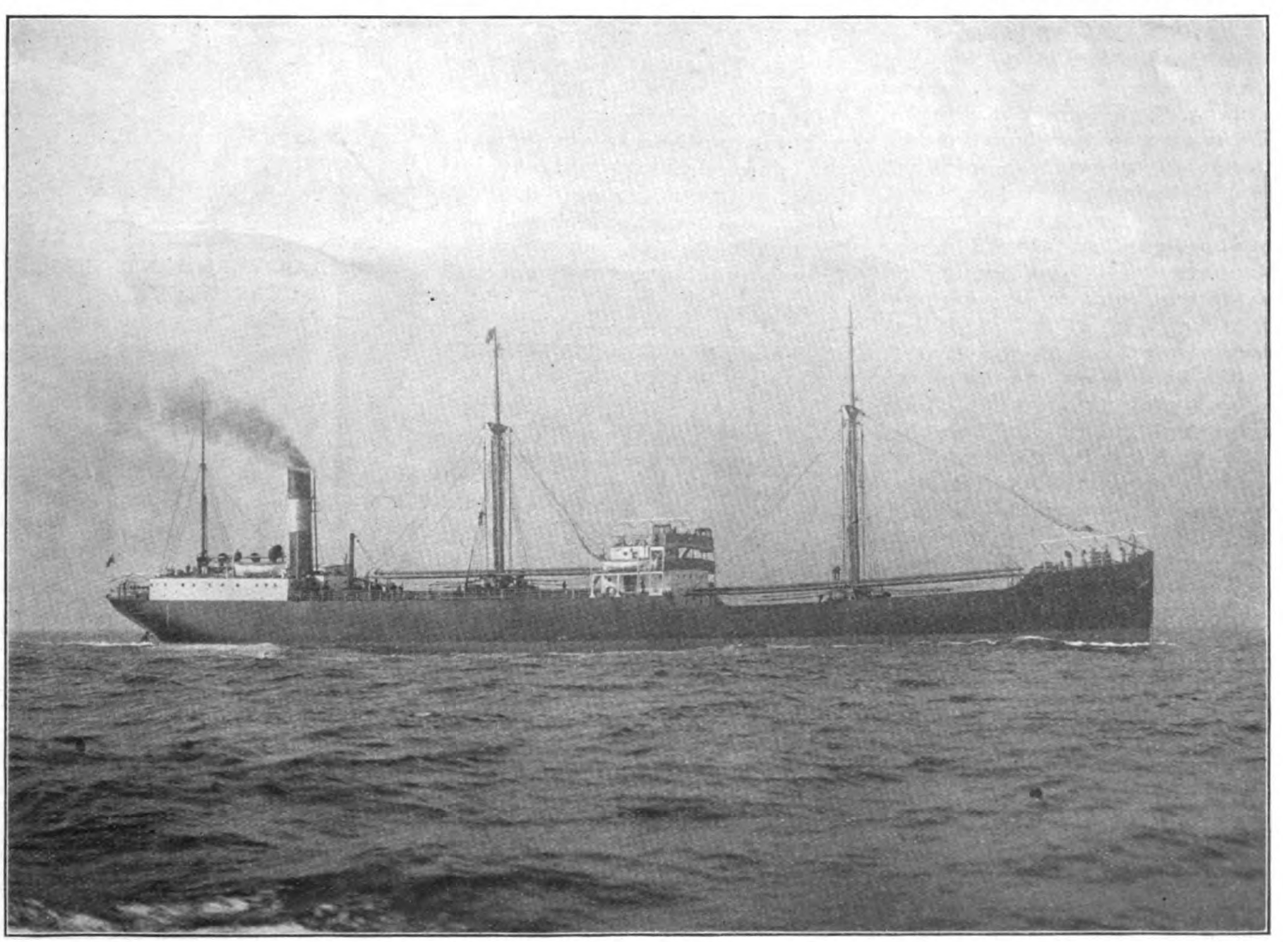
A spiral rotary cutter, for disintegrating clay or hard soil, is fitted at the lower end of the suction frame, this cutter being driven through steel spur gearing by a set of compound surface-condensing engines. The suction frame is controlled by independent steam hoisting gear. Bow and stern winches, of very powerful construction and arranged for rapid handling, are provided. The control of the dredger is centered on the operating bridge, on which are placed all telegraphs, speaking tubes and signals for controlling the cutter engines, pump engines and stern winch, as well as the handles for controlling the frame hoisting gear and the bow winch. One man can thus direct all the operations of the dredger and the pipe line.

The living accommodation and the general arrangements are all designed for working in a tropical climate, every attention having been given to light and ventilation. The vessels are electrically lighted throughout, having a powerful searchlight for manipulating the pipe line when working at night. Telephone communication between the dredger and the end of the pipe line is also provided. The vessels, as launched, were complete and ready for trials.

The passenger steamer Mackinac, building by Johnston Bros., Ferrysburg, Mich., for George L. Craig, of Toledo, O., was launched on May 26. The Mackinac is 150 ft. over all, 136 ft. keel, 28 ft. beam and 11½ ft. deep. Her engine is compound with cylinders 18 and 40 in. diameter by 30 in. stroke, supplied with steam by two boilers, 6 ft. 6 in. by 12 ft.

The Carnegie Coal Co. of Pittsburg has closed a lease for the coal dock property operated by the Great Northern Railroad on St. Louis Bay. The company owns and operates several mines in the bituminous district of Pennsylvania.

The Craig Ship Building Co., Long Beach, Cal., is building a dry dock at its plant.



STEAMSHIP FIONA, DESIGNED FOR SUGAR TRADE AND BUILT BY SIR RAYLTON DIXON & CO., MIDDLESBROUGH, ENGLAND.
For description see MARINE REVIEW *for May.*

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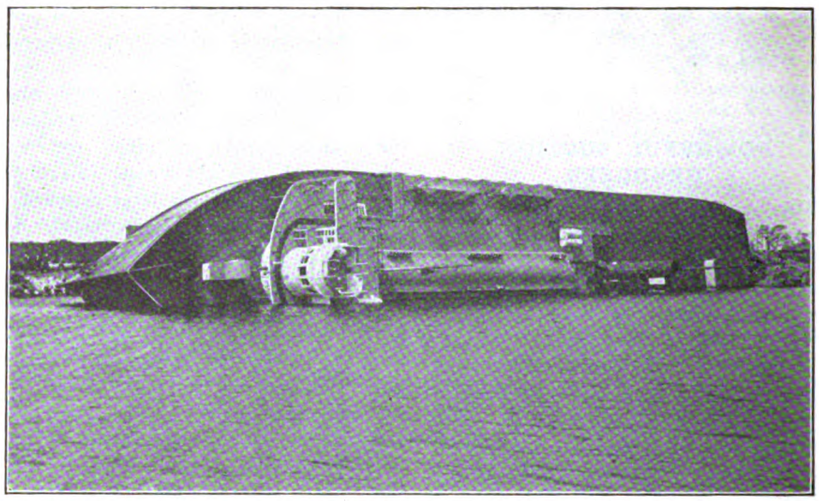
CAR FERRY ANN ARBOR NO. 4 TURNS TURTLE.

The car ferry Ann Arbor No. 4 turned turtle in the loading slip at Manistique on Saturday, May 29, with 24 cars of iron ore. The accident happened while the ferry was being loaded, the two center tracks being filled with loaded cars, and the cars being placed on the port tracks. There were eight cars in the string, two of which were to be put on the port track. When the cars left the apron the ferry began to list, dragging the remaining cars onto the boat and breaking away from the locomotive. It is estimated that fully 10 minutes elapsed from the time the ferry began listing until it turned completely over. When it had turned partly over the cars on the center tracks crashed onto the port track, tearing away the stanchions and smokestack and sending the boat to the bottom. The wrecker Favorite is at work on the wreck. A cofferdam is being built about the stern of the car ferry and the cars are being removed by the crane. It will probably be several days yet before the ferry is righted.

CANADIAN LOCK OF SAULT CANAL WRECKED.

The Canadian lock of the Sault canal was wrecked on June 9, when the steamer Perry G. Walker, of the Gilchrist fleet, rammed her bow through the lower gate, through a mistake of signals. Definite information is lacking, but the accident appears to have been caused by a misunderstanding of signals, Capt. Moosher of the Walker declaring that his signals to back up were interpreted by the engineer as full speed ahead. The upper gates were open when the Walker broke down the lower gates and converted the canal into a mill-race with all the power of Lake Superior behind it. The Canadian Pacific passenger steamer Assiniboia was moored within the lock chamber at the time. She was torn from her moorings and overtaking the Walker ripped a hole in the Walker's side with her port anchor. The bulk freighter Crescent City of the Pittsburg Steamship Co.'s fleet, loaded with ore, was just entering the locks when the accident occurred. Riding on the crest of the waves, she was swept down stream with tremendous velocity, overtaking the Assiniboia, striking her a glancing blow and tearing a great hole in her own side as she swept past the broken lower gate. Tugs caught her and towed her to the American side, where she settled on the bottom. Meanwhile the Assiniboia had reached open water below with slight injuries. The Walker was whirled around several times and finally landed in a shoal out in the stream, not greatly injured.



CAR FERRY ANN ARBOR NO. 4 AS SHE LIES AT THE DOCK.

Both upper gates of the lock and one lower gate were wrenched from their fastenings. The other lower gate still hangs to its fastenings, twisted and broken. This is the first serious accident that has happened to the locks at the Sault since they were constructed in 1855. The Canadian lock was finished in 1896 and is 900 ft. long and 60 ft. wide.

The movable dam across the Canadian canal has been lowered with the exception of one leaf, which is so twisted that it is impossible to lower it. Preparations are now being made to timber this part of the dam and thus control the water, which is now rushing through the aperture with great force.

CLEVELAND INDUSTRIAL EXPOSITION.

The Cleveland Industrial Exposition which opened Monday, June 7, is creditable throughout, and doubtless surprised many in its great variety. It needed only this exposition to prove that Cleveland in diversified manufacture is hardly excelled.

The exposition was formally opened by Charles F. Brush, president of the chamber of commerce, and F. F. Prentiss, chairman of the exposition committee, who more than any other man had to do with furthering this project. Its success was so instantaneous that it is quite likely to become an annual feature of Cleveland life.

Naturally its maritime display is considerable, and much thought has been expended in making the booths attractive. For instance, the Upson-Walton Co. have an excellent model of the lake freighter J. Pierpont Morgan; the C. O. Bartlett & Snow Co., a model of conveying machinery in actual operation; the Brown Hoisting Machinery Co. and the Wellman-Seaver-Morgan Co., have fine displays of machinery well known from one end of the lakes to the other. The Chase Machine Co. also make an excellent display of their specialties. Among other firms that cater in part to the marine trade exhibiting may be mentioned the Cleveland Punch & Shear Works, the Cleveland City Forge & Iron Co., the Chisholm & Moore Mfg. Co., the Bruce-Macbeth Engine Co., the Nicholson Ship Log Co., the Glidden Varnish Co., the Forest City Paint & Varnish Co., the Sherwin-Williams Co., and Warner & Swasey.

MORE GOVERNMENT ENGINEERS NEEDED.

Asserting that "the duties devolving upon the officers of the corps of engineers are now greater than ever before in its history," Brigadier-General William L. Marshall, chief of engineers, U. S. A., in his annual report, presents the need for an enlargement of the personnel "if the work is to be carried on with the same high standard of efficiency which has previously ever characterized it." With the same enlisted strength as at present he sees the necessity for an increase of 60 in the authorized number of engineer officers. This increase should be only in the grades above that of second lieutenant, as officers of that grade are not available for, and should not be assigned, either to the charge of construction work or as assistants thereon. It would add four colonels, 7 lieut.-colonels, 13 majors, 18 captains, and 18 first lieutenants. The increase is due entirely to the need for officers, and has nothing to

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do with the demands for engineer troops and for officers to command them. As showing the great demand for engineer troops, it is noted that in the early part of the year 1907 nine of a total of 12 engineer companies were actually on duty in the tropics, a much greater proportion than in the case of any other branch of the service, and a result arrived at only by leaving an entirely inadequate number of engineer troops for the work in the United States. The matter of an increase in the enlisted force of the engineer corps has been under consideration by the general staff, and it is understood that there will be recommended an increase in the number of battalions from three to six. In this recommendation General Marshall heartily concurs.

OBITUARY.

John A. Ubsdell, who was for 22 years manager of the Eads jetties at the mouth of the Mississippi river, died at New Milton, England, on April 23, last. He was born in New York City in 1842. He was associated with James B. Eads in the construction of the celebrated Eads bridge at St. Louis and Eads jetties at South Pass, La. He married Genevieve Eads, the daughter of James B. Eads. His life was an extremely active one and he was well known in New York, St. Louis and New Orleans. He was an associate of the American Society of Civil Engineers and a member of the Lotus Club of New York. He is survived by his widow and two sons, John A. Ubsdell, of Detroit, and Thurlow Ubsdell, of England.

Capt. Michael J. Galvin died at his home in Buffalo on May 31. He had been prominently identified with the marine trade of Buffalo for many years. He was appointed United States inspector of steam vessels in 1894 by President Cleveland. He later formed the Galvin Transportation Co. and engaged in the pulp wood trade.

Capt. David F. Edwards died at his home at Toledo on May 28 at the age of 90 years. For nearly half a century he was a builder of lake vessels.

Frank Reilly, chief engineer of the steamer Black Rock, died at Milwaukee on May 30 as the result of an automobile accident.

STEAMER UNITED STATES.

The new steamer United States, of the Indiana Transportation Co.'s fleet, left the yard of the Manitowoc Dry Dock Co., Manitowoc, Wis., on May 20 on her maiden run to Chicago. About 100 business and professional men from Chicago, Milwaukee and neighboring cities made the trip as the guests of the steamship company. The steamer stopped at Milwaukee enroute where she was given quite a reception.

The United States is 215 ft. long, 40 ft. beam and 17 ft. deep. There are 45 staterooms named after various states instead of being numbered. The machinery consists of a triple-expansion engine with cylinders 22, 36½ and 60 in. diameters by 40-in. stroke, supplied with steam from three large Scotch boilers, 13 ft. 3 in. by 12 ft. 4 in.

THE BATTLESHIP TEMERAIRE.

The new battleship Temeraire, of the "improved Dreadnought" type, was commissioned a few days ago at Devonport. There are now six warships of the Dreadnought class in commission, namely the battleships Dreadnought, Bellerophon and Temeraire, and the battle-ship cruisers Indomitable, Inflexible and Invincible. The Temeraire, which was laid down on Jan. 1, 1907, at Devonport, has a displacement of 18,600 tons. Her turbines will indicate 23,000 H. P. In her steam trials her highest speed was 22.07 knots. Her main armament consists of 10 12-in. guns of the X-mark type, each worked by hydraulic power, and having a range of 15 miles. Each turret weighs 400 tons, and is protected with 12 in. of steel armor, while each gun weighs nearly 60 tons, and is provided with 80 rounds of ammunition. In working the guns the hydraulic pressure is 1,000 lb. to the sq. in. The bore of each of the 12-in. guns is fitted to receive a six-pounder gun for sub-caliber practice, so that while the gunlayers are put through all the operations of training and laying a 12-in. gun up to the point of pressing the trigger, only the six-pounder is discharged from the big-gun. The combined searchlights of the Temeraire are equal to about 4,000,000 candlepower, while her wireless telegraphic apparatus carries 1,100 miles. The capacity of her coal bunkers is 2,400 tons, and at full speed her daily consumption would be 500 tons. In the new ship are more than 150

SUMMARY OF NAVAL CONSTRUCTION.

The monthly summary of naval construction, issued by the bureau of construction and repair, shows the following progress upon vessels:

Name of Vessel—	Building at—	—1909— Per cent of completion. April 1.	May 1.
BATTLESHIPS.			
South Carolina	Wm. Cramp & Sons	86.9	90.0
Michigan	New York S. B. Co.	95.2	97.4
Delaware	Newport News S. B. Co.	73.0	77.9
North Dakota	Fore River S. B. Co.	77.9	81.5
Florida	Navy Yard, New York	8.4	11.9
Utah	New York S. B. Co.	10.8	14.9
TORPEDO BOAT DESTROYERS.			
Smith	Wm. Cramp & Sons	71.4	81.6
Lamson	Wm. Cramp & Sons	69.4	75.7
Preston	New York S. B. Co.	64.1	70.7
Flusser	Bath Iron Works	63.2	68.7
Reid	Bath Iron Works	63.0	67.8
Paulding	Bath Iron Works	7.0	9.8
Drayton	Bath Iron Works	7.0	9.7
Roe	Newport News S. B. Co.	29.5	38.6
Terry	Newport News S. B. Co.	27.4	33.7
Perkins	Fore River S. B. Co.	15.7	22.0
Sterrett	Fore River S. B. Co.	15.7	22.0
McCall	New York S. B. Co.	10.5	11.7
Burrows	New York S. B. Co.	10.0	11.3
Warrington	Wm. Cramp & Sons	12.4	16.0
Mayrant	Wm. Cramp & Sons	12.2	15.1
SUBMARINE TORPEDO BOATS.			
Stingray	Fore River S. B. Co.	82.0	89.8
Tarpon	Fore River S. B. Co.	81.7	89.7
Bonita	Fore River S. B. Co.	76.7	81.4
Snapper	Fore River S. B. Co.	76.3	80.4
Narwhal	Fore River S. B. Co.	84.2	89.7
Grayling	Fore River S. B. Co.	77.8	84.6
Salmon	Fore River S. B. Co.	66.6	75.3
Carp	Union Iron Works	0.0	0.0
Barracuda	Union Iron Works	0.0	0.0
Pickerel	The Moran Co.	0.0	0.0
Skate	The Moran Co.	0.0	0.0
Skipjack	Fore River S. B. Co.	0.0	0.0
Sturgeon	Fore River S. B. Co.	0.0	0.0
Thrasher	Wm. Cramp & Sons	0.0	0.0
Tuna	Newport News S. B. Co.	0.0	0.0
Seal	Newport News S. B. Co.	8.8	12.7
COLLIERS.			
Vestal	Navy Yard, New York	98.6	98.6
Prometheus	Navy Yard, Mare Island	98.5	98.9
TUG BOATS.			
Patapsco	Navy Yard, Portsmouth	99.0	99.0

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electric motors, used in pumping water, hoisting ammunition, coaling, ventilating the living spaces, cooling magazines, working tools, firing the guns, compressing air for torpedoes, generating force to operate the high-power wireless telegraphic apparatus, and illuminating the battleship throughout.

SUBMARINES LAUNCHED.

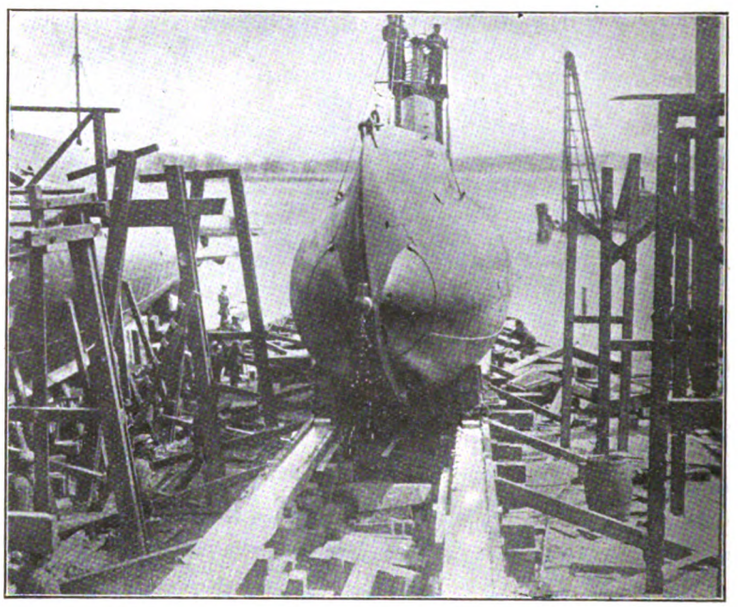
The Holland submarine torpedo boats Narwhal, Tarpon and Stingray were launched from the works of the Fore River Ship Building Co., Quincy, Mass., recently. The Tarpon and Stingray are 105 ft. long and are duplicates of the Octopus. The Narwhal is 135 ft. long.

THE HALF MOON'S PLANS.

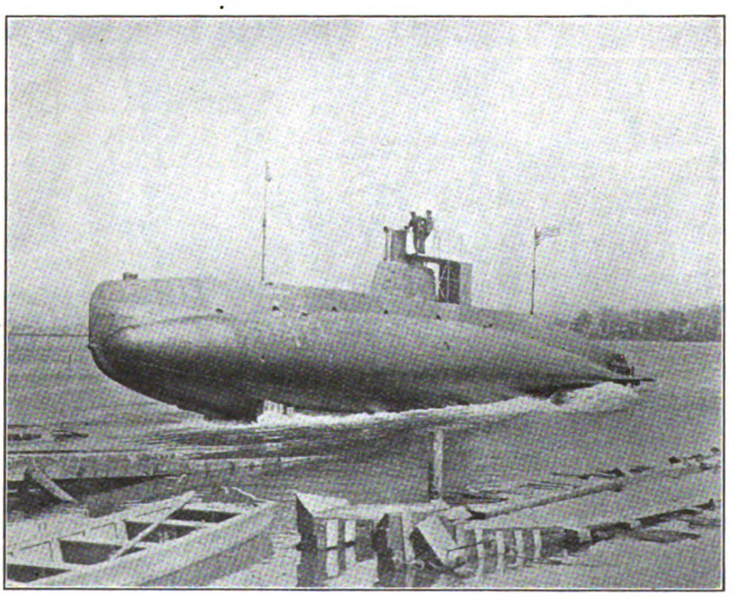
The Commissie voor de Hudson-Fulton Gedachtenisviering, which is the organization of patriotic citizens of Holland who are building the replica of Henry Hudson's ship, the Half Moon, has selected a committee to represent that organization upon the presentation of the replica to the Hudson-Fulton celebration commission this fall. This committee will be the official guests of the commission. They are: J. T. Cremer, president of the Netherlands Trading Society, and former secretary of state for the colonies, who is vice president of the Holland commission; R. van Rees, treasurer; J. Heldring, assistant secretary; Jonkheer O. Reuchlin and J. Rypperda Wierdsma, managing directors of the Holland-America line; S. P. van Eeghen, president of the chamber of commerce, Amsterdam; Baron J. d'Aulius de Bourouill, professor at the University of Utrecht; J. C. de Marez Oyens, ex-secretary of state for commerce; and Baron J. C. van Tuyll van Serooskerken, comptroller of her majesty's crown lands.

In addition to the above, E. J. Benthem, an engineer of the royal navy, will probably sail for the United States in the beginning of September. Mr. Benthem has been in charge of the construction of the Half Moon, and his presence in New York is essential to the rigging of the vessel, as he is the only man who is entirely familiar with this important work.

The replica of the Half Moon will be manned by Dutch sailors during its participation in the Hudson-Fulton celebration this fall. The Netherlands government will send instructions to Capt. von Hecking Colenbrander, commander of H. M. Utrecht, to sail for New York in August. She is due to reach that port about September 15. The crew to man the replica of the Half Moon will be selected from the roster of the Utrecht. Lieut.-Commander W. Lam, R. D. N., will impersonate Henry Hudson, and Lieut. De Meester, R. D. N., will act as the mate of the Half Moon.



LAUNCHING SUBMARINE TORPEDO BOAT TARPON.



LAUNCHING SUBMARINE TORPEDO BOAT STINGRAY.

PACIFIC MAIL TO STOP ITS PANAMA SERVICE.

Traffic officers of the Pacific Mail Steamship Co. at New York on June 2 informed shippers that the line will withdraw its Panama service on August 3. It was stated that notice to this effect had been served on the war department at Washington, which has charge of the operation of the Panama railroad, with which the Pacific Mail has certain traffic arrangements. The company contemplates giving up the service because of its unremunerative character. The rate received on shipments from the west coast to the isthmus and thence via the Panama Railroad & Steamship Co. to New York is $8 per ton, of which the Pacific Mail Steamship Co. receives $4.

The Maryland Steel Co., Sparrow's Point, Md., launched the collier Vulcan for the United States navy on May 15.

The light house tender Hyacinth, stationed on Lake Michigan, will be equipped with submarine signals.

The Central Dredging Co. of Cleveland has purchased the tug Carl of the Milwaukee Tug Line.

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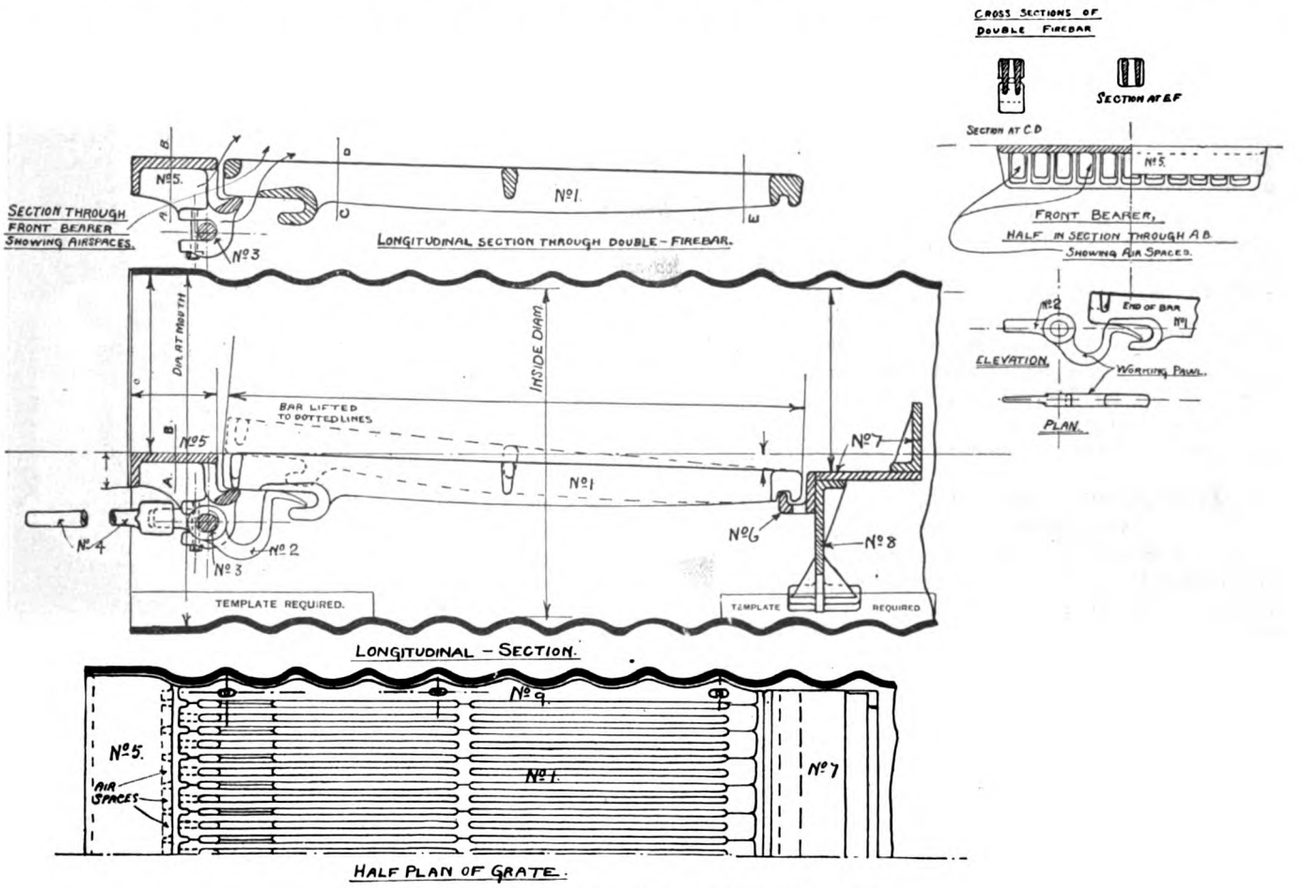
THE "CAMPBELL" PATENT FIRE BAR.

The patent fire bars which are manufactured by the patentees, Messrs. Railton, Campbell & Crawford, engineers of Liverpool, have during the past few years been adopted by nearly every leading steamship company in Great Britain, and for this reason they will be examined with more than usual interest by American users. These bars have recently been greatly improved by the firm. To understand the improvements its is necessary to give a brief description of the original design of fire bar and apparatus, which provides a simple means for facilitating the removal of clinker from the grate, and for enabling any of the grate bars to be moved. A lug is formed beneath each grate bar at the forward end, each lug having a socket in its front face. The grate bars are supported upon cross plates having beveled faces, which are adapted to be engaged by similar faces on the ends of the grate bars.

The bars are not connected together, but each is free, and can be moved vertically without disturbing any of the others. Beneath the front plate of the furnace is suspended a horizontal bar the hangers by which the bar is suspended being screwed into the under side of the front plate, and provided with horizontally arranged lugs at their lower ends into which the horizontal bar is slipped, and in which the bar is secured by bolts passing through the lugs on the hanger. The center part of this horizontal bar is free from any obstruction, the supporting hangers being arranged at the ends of the bar beyond the sides of the grate. On the bar is mounted a double lever, the forward end of which is adapted to engage in the sockets on the lugs of the grate bars.

The lever is so mounted on the horizontal bar that it can be slid along the whole length of the furnace front into any desired position and can be made to engage with any one of the hangers on the grate bars. The portion of the lever which engages round the horizontal bar is bell shaped, so as to allow the lever to be rocked sideways to some extent, and to render its movement along the horizontal bar easy. A squared arm projects outward from the lever and is engaged by a bar having a socket in its end. When it is desired to clinker the furnace, the stoker fits the socketed handle upon the end of the pivoted lever, and moves it along the horizontal bar to the grate bar which requires to be moved. He then depresses the handle, and as the forward end of the lever engages in the lug on the grate bar, the bar is raised and shaken as required.

If the grate bar should become wedged in its raised position, the stoker may force it down again by pulling upwards upon the handle, causing the lever to press upon the lower side of the socket in the hanger on the grate bar and forcing it down into position again. The



CAMPBELL PATENT FIRE BAR OF RECENT DESIGN.

accompanying illustrations show the Campbell patent fire bar of the most recent design. The figures on the drawings show the parts supplied by the makers, the references being as follows: No. 1, double bar; 2, working pawl; 3, wayshaft; 4, portable lever; 5, front bearer; 6, back-bearer; 7, back bridge; 8, half-moon; 9, wing bar and strip. The design and construction will be readily understood from the drawings. The improvements have been the result gained by the experience with the original design in many hundreds of steamships.

The latest style of furnace bars has several important advantages over the previous system. It

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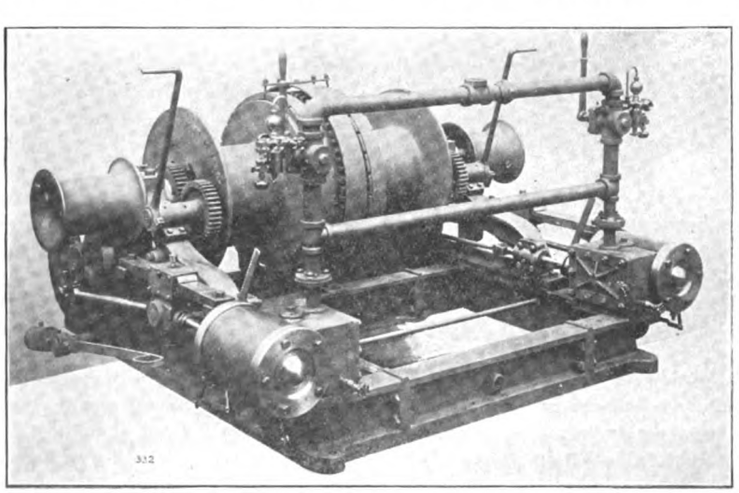
will be noted from the drawings that the front bearer is formed in grate fashion so as to admit of the air going right through the bars. It will also be observed that the bars are square headed and rest on the underlip of the front bearer. There is also an important alteration in the working pawl which gives greater leverage up to 1½ in. lift, and up to 5 in. the lifting is much easier for the firemen. The bars have also been made wider at the back than at the front, and also diamond shaped. The makers claim for this new style an even longer life for the bars and besides improved steaming. And in this connection it may be remarked that there are vessels under the White Star flag which were fitted with the older style of bars five years ago, and they are still in use, none of the bars having as yet had to be renewed. The White Star among other British lines have after a trial of the new design given them their approval, and are now adopting them through the whole of their fleet. These improved fire bars have already been fitted on some 200 steamers, and they have besides been adopted by the Cunard, as well as most of the leading British and German companies.

AUXILIARIES OF BULL STEAMER.

The steering engine of the new steamer, building at the Newport News yard for the A. H. Bull Steamship Co. of New York, described elsewhere in this issue, is being supplied by the Lidgerwood Mfg. Co., of New York, and is of twin-cylinder type with cylinders 7 in. diameter by 7 in. stroke. In general features it resembles the usual class of steering gear installed on vessels of this type, but differs materially in matters of detail. Like all the machinery made by this concern, the individual parts are finished to gage, on the interchangeable part plan, the advantage of this being that in case of breakage or wear new parts can be procured and installed without loss of time. The gear worm is in two parts, this arrangement allowing for adjustment in case of wear and preventing back lash in the worm wheel. Roller thrust collars are fitted at each end of the worm wheel.

The cargo winches will have double friction drums, with extra large gypsy heads for general use on either outboard side. Each friction drum will be fitted with Lidgerwood double wood frictions with cork inserts. This type of friction drum for hoisting engines is handled exclusively by this company and has many advantages over the ordinary types. Although having enormous holding power and easily operated they are not affected by oil, water or other usually objectionable substance. The friction levers are connected to the cams by gear wheels in such manner that little effort is required to operate the drums. The vessel will carry five winches.

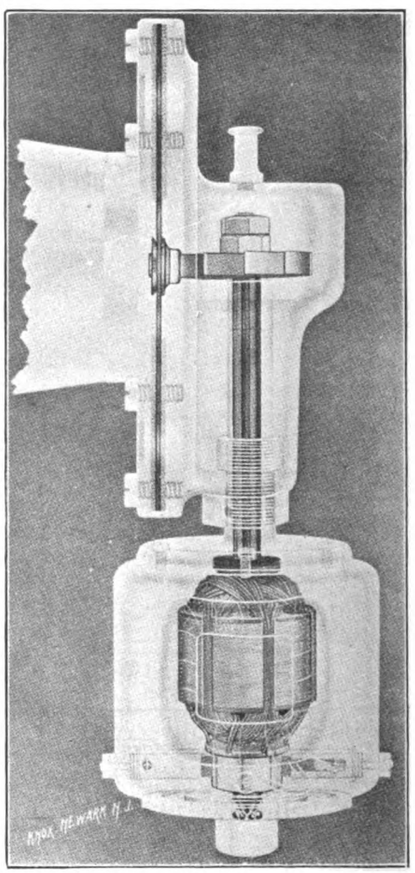
A special winch, located amidships, will be used in coaling the vessel. This winch will be operated by a single-cylinder engine and differs from the others in that the shaft extends some distance on either side, carrying a friction drum and an extra large gypsy head at each end.



CARGO WINCH FOR BULL FREIGHTER.

MARINE WARNING SIGNAL.

During the dense fogs that prevailed in the harbor of New York at the close of last year much inconvenience and delay resulted from the difficulty encountered by the ferry boats in finding their slips, the large fog bells ordinarily employed, and stationed on the projecting ends of the ferry slips, proving at times inaudible a short distance out in the stream. Owing to the difficulty of locating the source of sound in a fog, the bells, when heard, but indifferently fulfilled their function, so far as guiding the ferries direct to the slips was concerned. With the object of improving on the fog-bell system a marine warning signal, specially designed for projecting sound in whichever direction the apparatus is pointed, was installed on the end of Pier 10, North River. This signal was sounded at intervals of 10 seconds, in the course followed by the ferries of the Central Railroad of New Jersey and its Atlantic Highlands express steamers, alternately. Actual tests proved the sound was perfectly audible across the river and for a considerable distance down the stream, the source of the sound being always very definite. The docks were located without difficulty, as the pilots were enabled to quickly ascertain when they were deviating from the course by the diminution of sound when they were out of the range of the apparatus. The inventor is now designing and about to construct one of these signals, built on a large scale, for test, with the idea of permanent installation on this pier.



KLAXON WARNING SIGNAL.

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By referring to the accompanying illustration the simplicity and practical construction of the apparatus is apparent. A steel diaphragm or disc is supported around its periphery and has affixed to its center a small hardened steel piece. A small steel toothed wheel revolves at the back of the diaphragm and is so arranged that the teeth come in contact with the hardened steel piece. As the wheel revolves, deriving its power from a few dry cells, the ignition battery of an engine or other source, the diaphragm is vibrated, producing a sound of extreme harshness and penetration. The apparatus is so designed that the sound is projected in one direction, the whole being mounted on a swivel bracket capable of rotation so as to take in an entire circle.

This marine warning signal can be installed on any type of craft, can be attached to a convenient bulkhead, the deck, or mounted on top of the cabin or pilot house, in which latter case rotation is accomplished by a handle projecting through the roof, as with a search light, and is water proof. The inventor is Miller Reese Hutchinson, of New York, who has named his apparatus the Klaxon Warning Signal.

ELECTRIC DOCK CAPSTANS AND WINCHES.

The convenience of electric motive power is well illustrated in the applications shown in the accompanying views where electric motors are shown connected to a capstan and winch for use in hauling vessels up to the dock. In each case the outfit

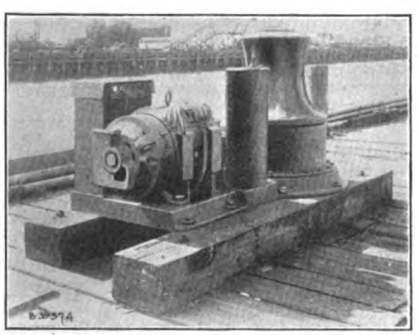


FIG. 1.

is entirely self contained with the entire outfit on a single bedplate, which insures correct alignment of the gearing even after long service. This construction makes the installation of the outfit a simple matter as it is only necessary to bolt the bedplate to a secure foundation and connect the motor to the power circuits. The location of the capstan

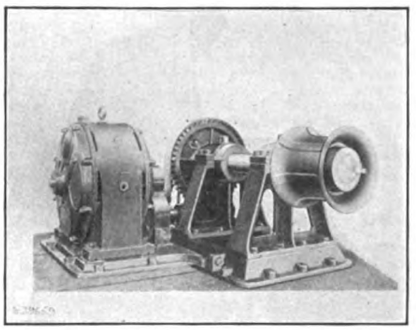


FIG. 2.

may be chosen without reference to the power for the wires may be run anywhere on the dock with much greater convenience at a substantial saving as compared to any other method of supplying power.

Fig. 1 shows one of the two electric capstans supplied by the American Ship Windlass Co., of Providence, R. I., to the Newport News Shipbuilding & Drydock Co., which they installed on piers in their ship yard at Newport News, Va.

With a capstan on each pier at the entrance of the drydock it is possible to haul the ships in very rapidly and accurately. The dock is one of the largest at any of the shipyards in the world and will take the largest American battleships afloat. It may readily be appreciated that powerful machines are required to do such work. Each winch is designed to pull 11,000 pounds at 30 ft. per minute. The motors are standard Westinghouse type "K" series wound motors running at a full load speed of 560 revolutions per minute. The speed is controlled by a standard Westinghouse R-27 controller.

The capstan is known as a 16-inch electric gypsy, that is, the barrel is 16 inches in diameter at the smallest part. The hauling rope is merely wound around the barrel four or five times and the loose end of the rope overhauled as the vessel is pulled into the dock by the winches.

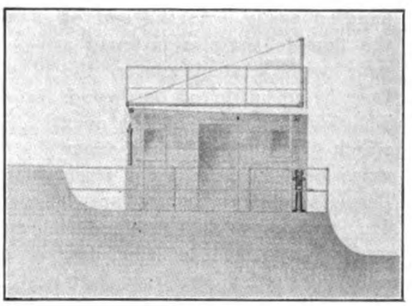
Fig. 2 shows a powerful winch which was installed by the Interboro Rapid Transit Co., of New York city, to haul barges alongside of the dock at their power station. It is driven by a 25-horsepower, three-phase induction motor of Westinghouse manufacture. With the motor running at 240 revolutions per minute the winch will have a speed of 24 ft. per minute and exert a pull of 18,000 pounds.

It will be noted that in the first case at Newport News series wound direct current motors are used and in the second case at New York a 3-phase induction motor of the short circuited secondary type is used. In each case the conditions are practically the same and the different types of motors are giving satisfactory service.

All of the winches were furnished by the American Ship Windlass Co., of Providence, R. I.

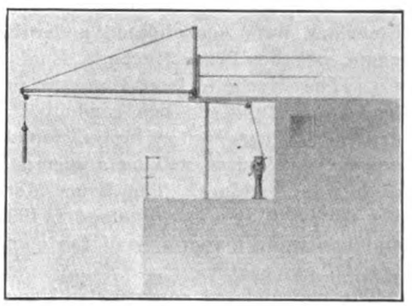
NEPTUNE SOUNDING MACHINE.

THE MARINE REVIEW in its April issue gave a description of the Neptune sounding machine which the Upson-Walton Co., Cleveland, are install-



OUTRIGGER AT REST.

ing on about 50 lake freighters this year. Herewith are given illustrations showing how an outrigger may be fitted forward at little expense to handle the machine with best results.



OUTRIGGER IN USE.

With the outrigger the machine is handiest to the captain and puts him in control of it at all times.

A FLEXIBLE SHAFT SANDER.

A flexible shaft sander recently placed on the market by the Coates Clipper Mfg. Co. has met with great success, especially in the manufacture of small water craft, being particularly adapted for sanding the curving bottoms of boats and canoes.

This sander, shown in the illustration, has been adopted by the Seth Thomas Clock Co. for obtaining the proper polish desired on the high

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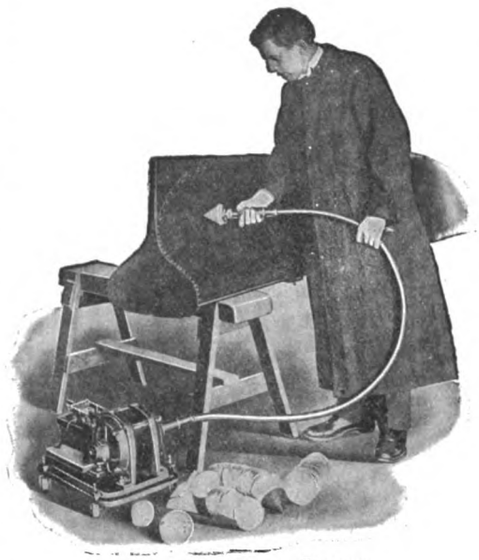
grade woods used in the construction of their clocks. They find that excellent results were obtained in this work, the outfit being very useful on account of it being so flexible and portable. The construction of this outfit is very simple. A General Electric ½ H. P. motor is fastened on a small truck supported at each corner by swivel rollers. At one end of the motor shaft is fastened a Coates unit link flexible shaft running inside a steel spring, this in turn being covered with leather, making a neat, durable and flexible shaft and one that can be handled easily. At the end of the flexible shaft is fastened a cone with a steel center, the base being made of hardwood. The body is made of felt over which is slipped sand-paper cones held in place by a steel garter. These sand-paper cones are inexpensive and may be obtained in any grade according to the degree of polish desired.

This little outfit is a veritable labor-saving device and being portable can be easily moved from place to place the result being that the operator can do better work in less time than with the usual methods.



FLEXIBLE SHAFT SANDER.

BRUCE-MACBETH ENGINE CO.

The Macbeth Iron Co. of Cleveland and the Bruce-Meriam-Abbott Co. of Cleveland have consolidated under the name of the Bruce-Macbeth Engine Co. The Macbeth Iron Co. was organized in 1870 and has conducted a general business as engineers, founders and machinists, making a specialty of blowing engines. The Bruce-Meriam-Abbott Co. was organized in 1900 and has made a specialty of the commercial gas engine.

The consolidated company will continue the business of both of the former companies on a more extended scale. The factory will be located at the former plant of the Macbeth Iron Co., on Center street, which will be enlarged to meet the new conditions.

The officers of the company are as follows: President, W. C. Bruce; vice president, C. W. Kelly; secretary and treasurer, C. J. Snow; manager, C. E. Curtiss. The officers with A. D. Macbeth, J. B. Meriam and F. B. Abbott, constitute the board of directors.

The B. F. Sturtevant Co., Hyde Park, Mass., have just put out two little booklets, one describing the Sturtevant gas booster to overcome low pressure and the other describing their electric fans. Both can be had for the asking.

The Algoma Central Steamship Line has sold the steamer Minnie M. to John Hickler, Sault Ste. Marie, Mich.

COMMERCE OF LAKE SUPERIOR.

During May 4,963,351 net tons of freight were moved through the canals at Sault Ste. Marie. This is quite a respectable showing considering the handicaps occasioned by labor disturbances. During April only 221,611 tons were moved, making the movement to June 1, 5,184,962 tons. It is a considerable gain over the corresponding period last year when 1,658,142 tons were moved, but last year vessel owners were in agreement not to open navigation until June 15, so that comparatively few vessels were operating. To get a real gage one must take the figures of 1907 when 8,922,877 tons were moved. The present year therefore shows a normal loss of 3,737,915 tons.

Following is the tabulated statement to June 1 of the present year with corresponding data for the two preceding years:

LAKE FREIGHT SITUATION.

Ore shipments during May were 3,253,275 tons as against 285,315 tons during May, 1908. Shipments to June 1, 1909, aggregate 3,309,068 tons as against 285,315 tons to June 1, 1908. The increase, therefore, over 1908 shipments to June 1 is 3,022,753 tons. It should be stated, however, that vessel owners were in agreement in 1908 not to open navigation until June 15, which accounts for the poor showing for that year in this statement. To get a real gage on the situation one must take the 1907 figures when 6,252,261 tons were moved to June 1. The normal reduction in this year's movement is therefore 2,943,193 tons. Following is the tabulated statement of the ore movement to June 1 of the present year with corresponding data for two preceding years:

IRON ORE SHIPMENTS.

Port.	May, 1907.	May, 1908.	May, 1909.
Escanaba	722,516	16,245	337,734
Marquette	366,826	.....	133,097
Ashland	479,924	21,128	232,184
Superior	994,504	132,818	608,515
Duluth	1,835,921	86,691	1,215,925
Two Harbors	1,221,594	28,433	725,820
	5,621,285	285,315	3,253,275
1909 Increase			2,967,960

Port.	To June 1, 1907.	To June 1, 1908.	To June 1, 1909.
Escanaba	1,014,339	16,245	384,856
Marquette	376,873	.....	133,097
Ashland	495,194	21,128	240,855
Superior	1,101,183	132,818	608,515
Duluth	1,937,830	86,691	1,215,925
Two Harbors	1,326,842	28,433	725,820
	6,252,261	285,315	3,309,068
1909 Increase			3,023,753

The prediction is that about 35,000,000 tons of ore will be moved during the present year. This will be approximately 10,000,000 tons more than last year and within 2,000,000 tons of the 1906 movement. Such movement will give the lake fleet reasonable employment after July 1.

As an index of dispatch, the steamer William E. Corey of the Pittsburg Steamship Co.'s fleet took on 10,234 tons of ore at Ashland in 63 minutes' actual loading time. She was in port 1 hour and 23 minutes. This is the

MOVEMENT OF PRINCIPAL ITEMS OF FREIGHT TO AND FROM LAKE SUPERIOR.

ITEMS.	TO JUNE 1, 1909.	TO JUNE 1, 1908.	TO JUNE 1, 1907.
Coal, anthracite, net tons	260,060	145,061	279,771
Coal, bituminous, net tons	836,800	308,088	1,812,507
Iron ore, net tons	3,028,609	262,882	5,796,767
Wheat, bushels	14,186,930	16,783,020	20,686,212
Flour, barrels	919,813	679,577	919,685

REPORT OF FREIGHT AND PASSENGER TRAFFIC TO AND FROM LAKE SUPERIOR, FROM OPENING OF NAVIGATION TO JUNE 1 OF EACH YEAR FOR THREE YEARS PAST.

EAST BOUND.

ITEMS.	TO JUNE 1, 1909.	TO JUNE 1, 1908.	TO JUNE 1, 1907.
Copper, net tons	21,613	14,264	14,872
Grain, other than wheat, bushels	6,965,045	5,366,534	9,123,765
Building stone, net tons	450	.....	.....
Flour, barrels	918,753	679,577	919,685
Iron ore, net tons	3,028,609	263,882	5,496,767
Iron, pig, net tons	3,808	2,964	1,725
Lumber, M. ft. B. M.	62,564	38,954	103,856
Wheat, bushels	14,186,930	16,783,020	20,686,212
Unclassified freight, net tons	29,136	10,237	8,219
Passengers, number	829	1,053	903

WEST BOUND.

Coal, anthracite, net tons	260,060	145,061	279,771
Coal, bituminous, net tons	836,800	308,088	1,812,507
Flour, barrels	1,060	.....	.....
Grain, bushels	.....	700	.....
Manufactured iron, net tons	61,192	47,856	50,576
Salt, barrels	164,340	163,534	113,206
Unclassified freight, net tons	156,992	93,486	147,731
Passengers, number	962	1,325	996

SUMMARY OF TOTAL FREIGHT MOVEMENT IN TONS.

East bound freight of all kinds, net tons	3,845,433	1,049,313	6,615,479
West bound freight of all kinds, net tons	1,339,529	618,829	2,307,398
Total freight, net tons	5,184,962	1,668,142	8,922,877

Total number of vessel passages to June 1, 1909, was 2,130, and the net registered tonnage, 4,340,531.

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best time that has ever been made in handling a cargo of that size, the nearest approach to it being the record of the Wolvin which took on a cargo of 10,000 tons in 90 minutes. The steamer Joseph G. Butler Jr. of the Hutchinson fleet arrived at Ashtabula at 2 A. M. June 8 with a cargo of 10,000 tons of ore. She discharged the cargo and was at the coal docks in Cleveland taking on a cargo of coal the same afternoon.

Such dispatch shows conclusively that notwithstanding labor difficulties the vessels are able to care for the trade. The Lake Carriers' Association reports that 263 of its vessels are in operation. It has an enrollment of 620 vessels, of which 90 are tugs, so that practically one-half of its bulk tonnage is now moving. Additional vessels are steadily going into commission and the indications are that the labor leaders are with difficulty holding their men in line. The center of interest during the week has been in Marine City where a number of engineers live. The report was current during the early part of the week that a number of them were going to their boats. Some of them have gone, but not as many as reported. There is no question but that the engineers individually would prefer to be at work. Some that are at work have received threatening letters from unknown sources. Vessel owners will pay $1,000 reward for information leading to their arrest. Disturbances on the docks are growing less. The longshoremen are taking a referendum vote which may naturally be supposed to be in favor of the striking element, but the dock managers declare that the outcome cannot seriously cripple the leading unloading points. It may somewhat delay the unloading of ore, but it cannot stop it.

The coal trade is quite active and there is a better demand for small carriers to Lake Michigan points.

MAY LAKE LEVELS.

The United States Lake Survey reports the stages of the great lakes for the month of May, as follows:

Lakes.	Feet above tide water, New York.
Superior	601.65
Michigan-Huron	580.84
Erie	572.54
Ontario	247.16

Since last month, Lake Superior has risen 3½ in., Lakes Michigan and Huron have risen 7 in., Lake Erie has risen 6¼ in., and Lake Ontario has risen 11¾ in.

During June, Lake Superior is likely to rise about 3¾ in., Lakes Michigan and Huron 3 in., Lake Erie 2½ in., and Lake Ontario 1 in.

Lake Superior is 8¾ in. lower than the average May stage of the past 10 years and about 4½ in. lower than last year. It is 3½ in. higher than in May, 1892, but 10 inches lower than in 1906 and 8¼ in. lower than in 1902.

Lakes Michigan and Huron show a stage ½ in. higher than the average May stage of the past 10 years and 6½ in. lower than last year, but 15¼ in. higher than in 1896. In May, 1886, the water was 32¼ in. higher.

Lake Erie is ¼ in. below the mean May stage of the past 10 years and 11¾ in. lower than in May last year, but 12¾ in. higher than in 1895. It is 14¾ in. lower than in May, 1878, and 18 in. lower than in May, 1887.

Lake Ontario is 7¼ in. higher than the average May stage of the past 10 years and 15½ in. higher than in May last year. In 1870 it was 21½ in. higher and in 1886 18 in. higher than in 1909. In May, 1897, it was 21 in. lower than this year.

WORK OF WEATHER BUREAU.

That the weather bureau is a real help to navigators was proved by the spontaneous expressions of vesselmen at a meeting of the Ship Masters' Association in Cleveland on April 30. Mr. Harvey D. Goulder outlined the work that the bureau is doing in all parts of the country and a number of vessel owners testified as to its efficiency on the great lakes. The weather bureau has latterly been made the object of attack by a leading magazine, but while meteorology is not an exact science it approximates exactness especially in the prediction of general storms. Local storms, of course, cannot be foretold owing to the very small area that many of them cover. The Ship Masters' Association adopted the following resolutions:

"Resolved that in navigation on the great lakes, the shippers, managers, and the masters keep close watch of the storm signals and weather forecasts of the government weather bureau service and greatly rely on the same in the navigation of the ships and find the same usually correct and so trustworthy and reliable that we have come to depend very much on the service; and

"Resolved that we deprecate criticism in generalities regarding the efficiency and value of the service, and give this voluntary testimony of our appreciation of the reliability and great value of the service as we find it in actual conduct and important use from day to day over so large and important a field as the great lakes."

SAILING DIRECTIONS FOR DETROIT RIVER.

President Livingstone of the Lake Carriers' Association is sending out the following letter of instructions to masters and pilots as to sailing directions for the lower Detroit river:

"Downbound vessels will pass the Limekiln crossing rock cut following the range 150 ft. from the west side of the channel, marked by the westerly targets (with red and white lights) at Texas dock and by the targets near the east shore of Bois Blanc Island. After passing Bar Point shoal lightship, they will keep the black spar buoys close aboard and enter Lake Erie via the channel passing to the west of Detroit river lighthouse.

"Upbound vessels will leave Lake Erie via the channel passing to the east of Detroit river lighthouse; and those of deep draught, after passing the red and black spar buoy north of the lighthouse, should keep within 400 ft. of the black spar buoys until the Bar Point shoal lightship has been passed. In passing through the Limekiln crossing rock cut, they will follow the range 150 ft. from the east side of the channel, marked by the easterly targets (with green and white lights) near Texas dock.

"That part of the channel between Bar Point shoal lightship and Detroit river lighthouse will be under improvement during a part of the season of 1909, and care should be exercised by all vessels when passing the dredges. Also, at about one-half mile south of Bois Blanc Island along Hackett range, all vessels should keep west of a line 150 ft. east of the Amherstburg range."

REGULATIONS FOR DULUTH-SUPERIOR HARBOR.

The war department, through Lieut. Col. Graham D. Fitch, government engineer at Duluth, has issued a revision of the rules and regulations for the canals and channels in the harbor of Duluth-Superior. The new matter is contained in paragraphs 32 to 36 as follows:

Dragging Anchors.

32. No vessel shall be towed while the anchor of such vessel shall be down or dragging at the bottom of the channel.

Towing Through Bridges.

33. Freight steamers shall not tow consorts astern while passing through the bridges of this harbor, the aerial bridge excepted. Towing alongside the steamer will, however, be permitted.

Patrol Signals.

34. Three distinct blasts of the steam whistle when sounded from a patrolling vessel will indicate that the vessel to w...ch such signal is given is proceeding at too high a rate of speed, and such vessel must immediately moderate her speed accordingly.

35. Three long blasts of the steam whistle followed by two short blasts when sounded from a patrolling vessel, will indicate that the vessel to which such signal is given must stop until further orders from the patrolling vessel.

36. One long blast followed by four short blasts, when sounded from the patrolling vessel, will indicate that the vessel to which such signal is given may proceed on her course.

NEW INSPECTION RULES.

Local inspectors of steamboats yesterday received a copy of the new rules of the inspection service. They are as follows:

"Section 53. It shall be the duty of the master of all loaded vessels to see that all hatches are properly covered and secured as soon as practicable after leaving port. Failure by the master of any vessel to observe this regulation shall be sufficient cause for suspension of his license on a charge of inattention to his duty.

"Rule 5, section 52, of rules and regulations: It shall be the duty of the master and the chief engineer of every steamer of over 50 gross tons to keep a log book showing where said steamer was navigated and dates of arrival and departure, as well as occurrences of importance concerning which evidence may be required.

"Revised Statutes, 4405—All steam vessels of over 100 gross tons, having sleeping accommodations below the main deck for passengers or crew, shall have such quarters equipped with a bell (electric or otherwise) to be operated from the bridge or pilot house of such steamers in case of disaster, such as fire, collision or foundering.

"Revised Statutes, 4417—No repairs or alterations affecting the safety of the vessel either in regard to hull or machinery, shall be made without the knowledge of the local inspectors. Notice of such repairs and changes is necessary, even if such work does not require the vessel to be placed in drydock, and even if there are no licensed officers attached to the vessel."

NEW CHANNEL AT ERIE.

The Great Lakes Dredge & Dock Co., Cleveland, has just completed dredging a 22-ft. channel from the harbor line to the Anchor line elevators at Erie, Pa. These elevators which have a capacity of 1,250,000 bu. will now be able to handle the largest cargoes of grain that come down the lakes without delay to vessels and without tug expense. The government has just completed soundings at the harbor entrance at Erie showing a depth of water ranging from 22 ft. to 28 ft. below mean lake level, so that the largest boat should have no trouble in getting into the harbor. The Anchor line elevators are equipped to elevate 16,000 bu. of grain per hour. Therefore with a shorter haul and with no tug expense, it would appear to be economy for vessel owners to charter cargoes of grain for transfer at Erie.

GOVERNMENT CONTRACT WORK.

The bids opened by Major Charles Kellar for the repair of north pier in the harbor of Manistee were as follows: Robert Love, Muskegon, Mich., $10.887.87; Bert Smith & Nelson, Muskegon, Mich., $11,424.69; Standard Construction Co., Chicago, Ill., $20,500.88.

The bids received by Lieut. Col. Graham D. Fitch, government engineer at Duluth, for furnishing rock for the government piers at Grand Marais, Mich., were as follows: W. A. Barney, Grand Marais, Mich., $1.35 per cu. yd.; J. F. Chisholm, Grand Marais, Mich., $2.20; W. C. Davidson, Grand Marais, Mich., $1.67. The bid of W. A. Barney was accepted.

Bids opened by Lieut. Col. J. G. Warren, government engineer at Cincinnati, O., for constructing Lock No. 13, Kentucky river, together with three dwellings, three out houses, three cisterns and one office building, were as follows: Ohio Contracting Co., Evansville, Ind., $291,015; J. C. Thomas, Louisa, Ky., $292,850; H. E. Talbot Co., Dayton, O., $317,590.98; E. G. Nave Bros. Co., Portsmouth, O., $314,633; Sheridan Kirk Contract Co., Cincinnati, O., $283,345; Bates & Rogers Construction Co., Chicago, Ill., $351,115; Mason & Hanger Co., Richmond, Ky., $284,235; Hollerbach & May Contract Co., Evansville, Ind., $296,755; Smith, Tolles & Co., Roderfield, W. Va., $272,960.

Contract has been awarded to L. D. Campbell of Duluth for the construction of a lighthouse near Split Rock on the north shore of Lake Superior about 50 miles from Duluth.

Major Charles S. Bromwell, government engineer, Milwaukee, Wis., opened bids for dredging 75,000 cu. yds. at Manitowoc harbor on May 18. The bidders were: Samuel O. Dixon, Milwaukee, Wis., $10,785; Greiling Bros. Co., Green Bay, Wis., $13,500; Fitzsimons & Connell Co., Chicago Ill., $13,500; Great Lakes Dredge & Dock Co. Chicago, $12,937,50; Ernest Schmidt, Two Rivers, Wis., $10,125.

The rebuilding of the federal pier of the interstate bridge, Duluth-Superior harbor, is now in progress. Scows are working alongside the pier, but one opening or t..e other will be clear the full width of 200 ft. at all times.

The annual report of the Pacific Mail Steamship Co. shows that its net earnings for the year were only $12,207. Charges for depreciation and extraordinary repairs for steamers amounted to $351,892, so that the total charges for the year were $339,684 in excess of the year's receipts.

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AROUND THE GREAT LAKES.

The steamer building for the Anchor Line by the American Ship Building Co. will be named Conemaugh.

The Central Dredging Co. of Cleveland has sold the tug Arthur Jones to the United States government.

The new steamer building for M. A. Hanna & Co by the American Ship Building Co. will be named in honor of I. M. Scott. She will be launched Saturday, June 12.

The new steamer City of Cleveland went into commission between Cleveland and Detroit on June 2, Capt. Alexander McKay, commanding.

The Detroit & Cleveland Line has issued a bulletin announcing that Saginaw is now reached by the Detroit & Cleveland steamers.

F. H. Osborn & Co., Chicago, Ill., announce the removal of their offices to suite 403, Fort Dearborn building, 134 Monroe street.

Capt. Alton Cornwall, local manager for the Great Lakes Towing Co. at Ashland for five years has been appointed local manager at Toledo.

The W. S. Rockwell Co., Hudson Terminal bldg., 50 Church street, New York, has just issued a little circular on the Rockwell Crucible Melting Furnaces.

John L. Fisher has resigned as business agent of the Firemen, Oilers and Watertenders' Association at Cleveland. Archie Dunn has been appointed in his place.

The battleship Mississippi successfully completed the journey of 275 miles from New Orleans to Natchez and return on the Mississippi during the last week in May.

The wooden steamer E. A. Shores Jr. has been purchased by the Detroit River Transit Co. from Joseph Miller of Marine City. She will be used to carry sand and gravel from Port Huron to Detroit.

The passenger and freight steamer Lakeside has been chartered by Mr. A. E. Thompson of Cleveland for operation between Cedar Point and Toledo for the season. She went into dry dock at Toledo for a new wheel.

Adeline Hawkins, a colored woman, was literally frightened to death by the powerful search light of the battleship Mississippi on its way up the river to Natchez. "It is the judgment light," she exclaimed, and fell dead.

The steamer J. H. Shrigley has been sold by the Huron & Erie Transportation Co. to the American Cedar & Lumber Co. and will be operated in the cedar and lumber trade between Alpena and Lake Erie ports.

The work of rebuilding the steamer Lewiston, Capt. John Green, Buffalo, has been completed, and she is now practically a steel ship. The Lewiston was formerly a composite of wood and steel. John Bateman, marine contractor of Buffalo, did the work.

Swan Hunter & Wigham Richardson, Wallsend-on-Tyne, laid the keels on Feb. 11 and 18 respectively, for two steamers of a special type designed for Canadian service on the great lakes. The ships, named Keywest and Keyport, completed their trials at sea May 10 and May 18, respectively. The steamers are 250 ft. long, 42½ ft. beam and 25 ft. deep. This despatch in construction is quite respectable.

The Cleveland & Buffalo Transit Co. announce the opening on June 12 of its new service between Cleveland, Erie and Buffalo. The steamer State of Ohio will take care of the business on this route, leaving Cleveland on even dates at 1:30 P. M., arriving at Erie at 9 P. M., leaving Erie at 11 P. M., and arriving at Buffalo at 5 A. M. The steamer will leave Buffalo on odd dates at 3:30 P. M., arriving at Erie at 9 P. M., leaving Erie at 11 P. M., and arriving at Cleveland at 6:40 A. M.

Swan, Hunter & Wigham Richardson, Ltd., Wallsend-on-Tyne, England, launched the single deck steel steamer Kaministiqua, built to the order of the Western Steamship Co., Ltd., Fort William, Ont., on March 9. The new steamer is to enter service on the great lakes. She is of the following dimensions. Length over all, 256 ft.; beam, 43 ft.; depth, molded, 25 ft. She will be fitted with a set of triple-expansion engines with cylinders 20½, 33 and 54 in., by 36 in. stroke, taking steam from two single-ended boilers working at a pressure of 180 pounds. The machinery was built by the Northeastern Engineering Co., Ltd., of Wallsend.

The Niagara Frontier Pure Water Conference has been organized for the purpose of putting a stop to the pollution of the great lakes and tributary waters. The conference is composed of a committee of three each from the cities of Buffalo, Niagara Falls, Lockport, Tonawanda and North Tonawanda, as these cities owing to geographical location are subject more than other cities to the consequences of water pollution from currents, prevailing winds and congestion of ice. The high death rate from typhoid fever would seem to prove this contention. The conference has enlisted the support of the state health boards of Ohio, Michigan and New York. Congressman James S. Simmons from Niagara Falls has introduced a bill to protect the public health of which the pollution of the waters of the great lakes is made a feature.

SHIP YARD NOTES.

The repairs to the transport Buford will be made by the Moore & Scott Iron Works, San Francisco, on its bid of $12,683.

The schooner Esther Ann was launched from the New England ship yard, Bath, Me., recently, for the Gilbert Transportation Co., of Mystic, Conn.

Cobb, Butler & Co., Rockland, Me., are building a four-masted schooner 175 ft. long, 39 ft. beam and 14 ft. deep for Capt. J. W. Haskell, of Bridgeport, Conn.

The Coast Transit Co. has given contract to the Maryland Steel Co., Sparrow's Point, Md., for a tank barge 234 ft. long, 35 ft. beam and 16 ft. 7 in. depth of hold.

The American-Hawaiian Steamship Co. has closed contract with the Maryland Steel Co., Sparrow's Point, Md., for three steamers of 9,000 tons each for its service between the United States and Hawaii.

The San Francisco & Portland Steamship Co. has given contract to the Newport News Ship Building & Dry Dock Co., Newport News, Va., for the construction of two large freight and passenger steamers.

John N. Robins, president of the John N. Robins Erie Basin dry docks, has retired from active management. W. H. Todd, formerly manager of the plant, has been elected president.

The non-magnetic yacht Carnegie, built for the Carnegie Institute of Washington, D. C., will be launched from Tebo's ship yard, foot of Twenty-third street, Brooklyn, N. Y., on Saturday, June 12.

Cobb, Butler & Co., Rockland, Me., has been awarded contract by the Benedict-Manson Marine Co., of New Haven, for a four-masted schooner to be 175 ft. long, 35 ft. beam and 14 ft. deep.

The New York Ship Building Co., Camden, N. J., has just delivered to the marine department of the New York Central railroad at New York a steel car float 332 ft. long, 40 ft. beam and 10¼ ft. deep, capable of carrying 16 cars.

Dearborn & Lapham, agents for the American-Hawaiian Steamship Co., announce that the company will build three new steamers for its service between New York, Hawaii and the orient. The plans for the steamers have not as yet been settled.

Robert Palmer & Son, Noank, Conn., are to build a steamer 165 ft. long, 36 ft. beam and 14 ft. deep for Howard Carroll, of New York, to be used in transferring the mails from trans-Atlantic liners off quarantine. The steamer will be fitted with two Almy water-tube boilers.

The Maryland Steel Co., Sparrows Point, have been awarded the contract for a large tar barge by the Barrett Mfg. Co., of New York, to take the place of barge No. 101, which was lost last December. The new barge will have a carrying capacity of 300,000 gallons of tar.

The Fore River Ship Building Co., Quincy, Mass., is to build a new steel auxiliary yacht 231 ft. long, 35 ft. beam and 16 ft. draught for Commodore James of the New York Yacht Club. Designs of the new craft will be prepared by Tams, Lemoine & Crane, of New York.

The John W. Sullivan Co., Ninth street and East River, New York, is to build a wooden tow boat 168 ft. long, 32 ft. beam and 12 ft. 6 in. deep for T. H. Franklin, of New York. The hull will be built by the Southern Ship Building Co., Tottenville, Staten Island. The Almy Water Tube Boiler Co. will supply the boilers.

Crawford & Reid, Tacoma, Wash., are to build a scow for the Tacoma Tug & Barge Co. to be 85 ft. long, 30 ft. beam and 8 ft. deep. Work will also soon be started on the cannery tender which is to be built at this yard for the Alaska Packing Co. This latter vessel will be 65 ft. long, 13 ft. beam and 6 ft. deep and is to be powered with 75 H. P. gasoline engines.

The two steamers that the Newport News Ship Building & Dry Dock Co. are building for the San Francisco & Portland Steamship Co. will have a length over all of about 380 ft., beam 47 ft. and depth molded to hurricane deck of 34 ft. The vessels will be schooner rigged with two steel pole masts and will have two tiers of deck houses above the hurricane deck.

The navy department has distributed contracts among coast ship builders for five torpedo boats, as follows: Bath Iron Works, Bath, Me., $659,000; New York Ship Building Co., Camden, N. J., $648,000; William Cramp & Son Ship Building Co., Philadelphia, $637,000; Newport News Ship Building & Dry Dock Co., Newport News, Va., $629,000; Fore River Ship Building Co., Quincy, Mass., $644,000.

The Ocean Steamship Co., better known as the Savannah Line, has given contract to the Newport News Ship Building & Dry Dock Co. for two freight and passenger steamers to operate between New York and Savannah. This makes five vessels that the Newport News Co has recently closed contracts for. Two of these are for the San Francisco & Portland Co, and one for the Associated Oil Co., of San Francisco. The latter is an oil burning tank steamer 390 ft. long, 49 ft. beam and 30 ft. deep.

Bids opened by the lighthouse board at Washington, D. C., on April 7, 1909, for the construction of light vessel No. 94 were as follows: Racine Boat Mfg. Co., Muskegon, Mich., $96,500; New York Ship Building Co., Camden, N. J., $113,500; Harlan & Hollingsworth Corp., Wilmington, Del., $99,950; Maryland Steel Co., Sparrows Point, Md., $114,325; Staten Island Ship Building Co., Port Richmond, S. I., N. Y., $100,000; William Cramp & Sons Ship & Engine Building Co., Philadelphia, Pa., $99,400; Fore River Ship Building Co., Quincy, Mass., $102,400; Pusey & Jones Co., Wilmington, Del., $120,000.

The keel of the replica of Robert Fulton's steamboat, the Clermont, was laid recently in the Staten Island Ship Building Co.'s yard at Mariner's Harbor. It will be launched about July 1 and will be fitted with a duplicate of the old engine. It will be ready to steam up the river by August 1. The Clermont will play a prominent part in the Hudson-Fulton Celebration this fall and will be seen in the naval parade from New York to Newburg, traveling under its own power with wood for fuel. After the parade the Clermont will continue its trip up the Hudson and will stop for one day at each of the six county seats that touch the river.

Thos. H. Franklin, of New York, has closed a contract with John W. Sullivan & Co., for a wooden steamer of 1,000 tons capacity, to engage in carrying coal between New York and Newburyport, towing one or more barges. The hull, which is to be built at Tottenville, S. I., by the Southern Shipbuilding Co., will be 168 ft. long, 32 ft. beam and 12½ ft. depth of hold. The engines will be built by John W. Sullivan & Co. They are two compound engines, with cylinders 12 and 24 in. in diameter and 18 in. stroke. Steam will be supplied by two Almy water tube boilers, each allowed a pressure of 200 lbs. It is expected the vessel will be ready for launching Aug. 1.

LUBRICATION AND LUBRICANTS.

Much has been written and spoken concerning the value of lubrication and how vital it is for efficient operation of any form of mechanism. Elaborate formulae have been given for testing different forms of lubricants, and literature of all kinds has been prepared with a view of exploiting all kinds of products of this nature. It is not, however, essential that one should acquire an education of oils and greases, but it is imperative that a first-class article be used, for should this not be done the engineer is gaining very expensive experience. Then the primary object should be to select a well-known product, something that has a reputation, and which has been gained because of satisfaction. This gives one a perfect lubricant, something that is known to have merit. The next thing to learn is where and how to apply it. Too much oil or grease is waste and has many other equally unsatisfactory qualities.

A practical and universally used lubricating agent is Albany Grease, manufactured by Adam Cook's Sons, 313 West street, New York, stated to be the first lubricant in the field being in practical use on all kinds of machinery for over forty years, and has been accepted as a perfect lubricant because of the good results under the most adverse conditions. Its use has been extended to every portion of the power plant where a solid lubricant may be employed.

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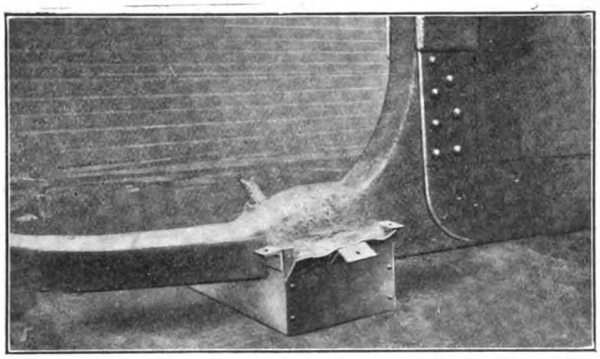

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work it is supposed to do, is cheaper than oil, a little goes a long way and the way is made a smooth one.

Albany Grease is made in seven densities designated by number, beginning with 0 and including 1, 2 and 3 and the X, XX and XXX, these being suited to conditions and temperatures. The difference is simply in consistency. Albany Grease is packed in 1, 5, 10, 25 and 50-pound cans and kegs, half barrels and barrels. It can be procured throughout the world from engine and mill supply houses, hardware, oil and automobile dealers and to avoid substitution it is always well to look for the distinctive mark "The boy sliding down the plank." Some interesting information relative to the qualities of the product will be sent for the asking.

TRADE NOTES.

THE SAFETY Car Heating & Lighting Co. in the last five months have made an unusual showing in the sales of their buoys and buoy lanterns. The Light has recently decided upon a more liberal lighting for the lower New York harbor and has placed orders for a sufficient number of Pintsch gas buoys, to enable the largest steamers to enter the harbor at night. The popularity of these buoys for harbor lighting is clearly evidenced by their general adoption, there being over 2,200 in service throughout the world, the principal countries using them as follows:

United States and Canada	497
England	439
Argentine	296
France	209
Germany	166
Holland	166

The recent government orders consisting of 18 Type B III buoys, 10 Type "C" spar buoys, and 23 extra buoy lanterns, again emphasize the great value of this invention for harbor lighting.

The Wellin Quadrant Davit and the Lane & DeGroot Co. have consolidated under the title of the Welin Davit & Lane & DeGroot Co., Consolidated. The new company is capitalized at $150,000 and the directors are John McMullen, A. P. Lundin, Ernest S. Suffern, John C. Silva, William Stevenson. The officers of the consolidated company are: A. P. Lundin, president and general manager; Ernest S. Suffern, vice president; John C. Silva, secretary and treasurer. The new consolidated company will conduct its business in the general offices on the 17th floor of the Whitehall building. The plant will be at the old Lane & DeGroot factory at 305-315 Vernon avenue, Long Island City.

The leading article in American Wire Rope News published by the American Steel & Wire Co. is descriptive of the wire rope used in a theatre, the Colonial theatre, Chicago, being selected as it is said to be the model stage in America. Over 10,000 ft. of wire rope are used in hoisting the steel curtain, the plush curtain and the border lights. An interesting article is also published on the declination of swamp lands in Indiana. Some excellent photographs are also published of the Swedish furnace. The superior quality of Swedish iron has been recognized for over 200 years.

The contract for the construction of the new city wharf at Beaumont, Texas, awarded H. D. Applegate & Sons on a bid of $29,500 has been executed and the work is expected to begin at once. This new wharf is to be 700 feet long and the wharf proper will be 15 feet wide, but will be filled in between the river bank and the outer edge, thus making a landing about 180 feet wide. The city now has on hand something over $50,000 derived from a bond issue and with which the wharf will be built. It is also the intention to erect warehouses and other facilities for handling Beaumont's rapidly growing water commerce.

The Falls Hollow Staybolt Co., Cuyahoga Falls, O., have just established two agencies in Canada, one including the territory west of Lake Superior, and the other the territory east of Lake Superior. The Brydges Engineering & Supply Co., 249 Notre Dame avenue, Winnipeg, will cover the former and Mussens Ltd., 279 St. James street, Montreal, the latter. The Falls Hollow Co. has also appointed H. J. Skelton & Co., Royal London House, Finnsbury Square, London, E. C., England, as its sole representative for the British isles and India.

The Gronkvist Drill Chuck Co., 18 Morris street, Jersey City, N. J., has issued a catalog devoted to the Johansson combination standard gage. C. E. Johansson, Eskilstuna, Sweden, the inventor and manufacturer of the gaging system described in the catalog, has been called the foremost tool maker in the world. The company maintains that Mr. Johansson's methods have reached such perfection that they can offer gages made accurate within one-millionth part of an inch per inch. The catalog describes the gages in detail.

The Frontier Engine Works of Buffalo, of which Capt. John Johnson and Abram Durr are proprietors, have purchased the Sutton Bros.' marine engine and propeller wheel patent. The company had been manufacturing the Sutton engines under the supervision of the late Francis Sutton, whose death occurred three months ago. The Sutton marine engines are widely known and the Frontier Engine Works will manufacture them, also the propeller wheels.

The Detroit Seamless Steel Tube Co. has just issued an attractive folder descriptive of Detroit seamless cold drawn open-hearth steel. The folder is illustrated with three photo-micrographs illustrating very clearly the difference in structure and density of steel. The illustrations are of common lap-welded steel pipe, lap-welded steel locomotive flue, and Detroit seamless cold drawn open-hearth steel locomotive flue.

The Queen City Engineering Co., Buffalo, N. Y., has just issued a little booklet describing their patent hydraulic steerer. The steerer is intended for power as well as hand steering, and it is claimed that the change from one to the other can be made instantly. The catalog describes the steerer in detail with numerous line drawings. The rear pages of the catalog are devoted to the Queen City Duplex steam pumps.

The Detroit Seamless Steel Tubes Co., Detroit, has just issued a very handsome little booklet concerning the "Detroit" hollow staybolt. This staybolt is made from the best grade of basic open-hearth steel. It is manufactured by the seamless process in which the tube is rolled over various mandrels compressing and compiling the material from the inside as well as the outside, thereby giving the steel great density.

HUTCHINSON & CO

The Royal Crown Lead Co., Detroit, Mich., has just issued a most attractive color sheet advertising their stack enamels for steamboats. They have reproduced in colors the stacks of 28 of the leading steamship lines on the lakes. Among the lines included are the Pittsburg Steamship Co., with its aluminum stack, Pickands, Mather & Co., with its black stack and red band, the Wolvin line with its green stack and aluminum band, the Great Lakes Towing Co., with its well known "G," and the Wyandotte Transportation Co. with its Indian.

The Joseph Dixon Crucible Co., Jersey City, N. J., has just issued a pocket edition general catalog of their products. It will be found very useful to anyone desiring information in brief with prices on their crucibles, facings, lubricating graphite, greases, pencils and protective plants. It is very attractively printed and is illustrated with a number of excellent wash drawings.

"Reactions," the quarterly periodical published by the Goldschmidt-Thermit Co., 90 West street, New York, contains a description of the new Thermit welding shops erected in Jersey City. An interesting description is also given of the Thermit repairs to a broken trolley of a traveling crane at a height of 80 ft. from the ground at the plant of the Commonwealth-Edison Co., Chicago.

The Detroit Seamless Steel Tubes Co., Detroit, has issued in attractive booklet form the paper by B. F. Sarver, of the Pennsylvania lines, to the International Master Boilermakers' Association, as read at their convention in Louisville in April last. In this paper Mr. Sarver dealt with the advantages of cold drawn seamless steel tubing for locomotive and marine boilers.

The Chase Foundry & Mfg. Co., Columbus, report that their April business shows an increase of 100 per cent and their May business an increase of 300 per cent over last year. This is an excellent index of trade revival, as the greater part of this company's output is sold directly to the manufacturer, which would indicate that manufacturers are preparing for increased trade.

The Glidden Varnish Co. has removed its general offices from the Rockefeller building, Cleveland, to the new Administration building just finished at its new plant. Ground was broken for this building in September last. Glidden wood oil marine coatings, waterproof concrete floor dressing, paints and varnishes are especially adapted for marine work.

Adam Cook's Sons, 313 West street, New York, have just issued a little catalog on Albany grease for which it claims that it does not drip, splash or wash away, is self-acting and runs only when the shaft is in motion and that it is impossible for the bearings to become overheated. Enclosed in the catalog is a free sample order blank.

The C. O. Bartlett & Snow Co., Cleveland, report the following recent orders: Benson Mines Co., Benson Mines, N. Y., one skip hoist; George H. Clippert & Bro. Brick Co., Detroit, Mich., one low pressure brick dryer, capacity 30,000 brick per day; Baldwin Bros., Cleveland, one gravel outfit for disintegrating elevating, screening and washing gravel.

The C. O. Bartlett & Snow Co., Cleveland, announce that it has established an office at 50 Church street, New York, in charge of H. H. Bighouse, chief engineer of the company. The eastern branch is prepared to give personal attention to all matters pertaining to the elevating, conveying and economical handling of materials as well as mechanical drying.

The Seidler-Miner Electric Co., contracting electrical engineers, Detroit, Mich., has just issued a little catalog descriptive of their electrical supplies. The list embraces a complete supply of water-tight fixtures and fittings for use aboard ship. The catalog will be sent to anyone upon request.

U. S. Engineer Office, Duluth, Minn., May 8, 1909. Sealed proposals for furnishing riprap at Ashland, Wis., will be received here until noon, June 8, 1909, and then publicly opened. Information on application. Graham D. Fitch, Lt. Col. Engrs.

U. S. Engineer Office, Duluth, Minn., May 7, 1909. Sealed proposals for furnishing stone and pebbles for Superior Entry, Wis., will be received here until noon, June 7, 1909, and then publicly opened. Information on application. Graham D. Fitch, Lt. Col. Engrs.

PROPOSALS.—Sale of U. S. S. *Zafiro*. —Sealed proposals will be received at the Navy Department until noon on the 9th day of June, 1909, at which time and place they will be opened, for the purchase of the U. S. S. *Zafiro;* appraised value, $5,000. The vessel will be sold for cash to the person or persons or the corporation or corporations offering the highest price therefor. *Proposals must be submitted in a sealed envelope addressed to the Secretary of the Navy, Washington, D. C., endorsed "Proposals for the purchase of the U. S. S. Zafiro," and each proposal must be accompanied by a satisfactory certified check for not less than 10 per cent of the amount of the offer.* On application to the Navy Department forms of bids and bonds, together with the terms and conditions of sale, also a printed list giving general information concerning the vessel, will be furnished. The vessel can be examined at any time after the date hereof by applying to the Commandant of the Navy Yard, Puget Sound, Wash. It must be removed from the limits of the navy yard within such reasonable time as may be fixed by the Department. The *Zafiro* is not entitled to American registry. The Department reserves the right to withdraw the vessel from sale and to reject any or all bids. G. v. L. MEYER, *Secretary of the Navy.* 5-1-09

U. S. Engineer Office, Milwaukee, Wis., April 28, 1909. Sealed proposals for dredging at Manitowoc harbor, Wis., will be received here until 3 p. m., May 18, 1909, and then publicly opened. Information on application. Chas. S. Bromwell, Major, Engrs.

SEALED PROPOSALS will be received at the office of the Light-House Engineer, Buffalo, N. Y. until 11 o'clock A. M., May 28, 1909, and then opened, for constructing a light-house and an iron beacon at the entrance to Cleveland Harbor, Ohio.

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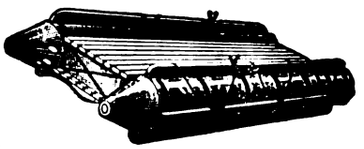

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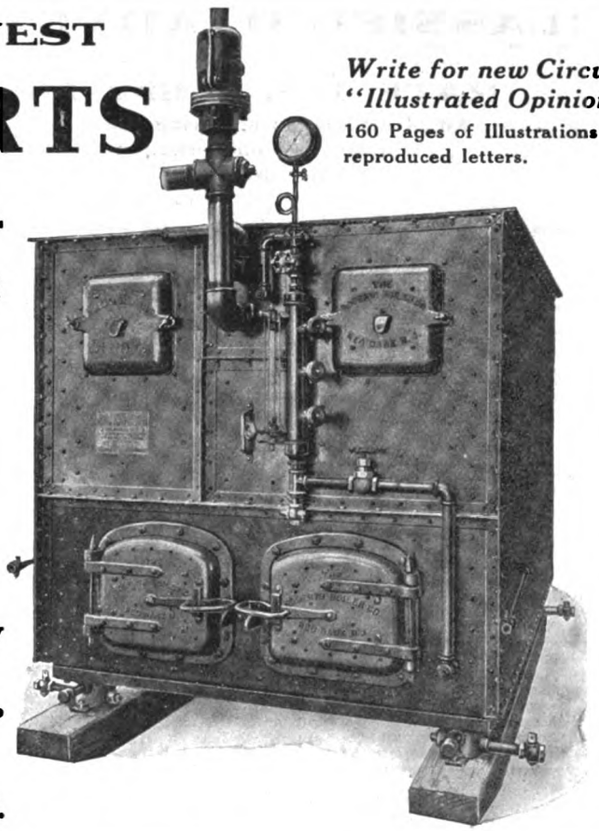

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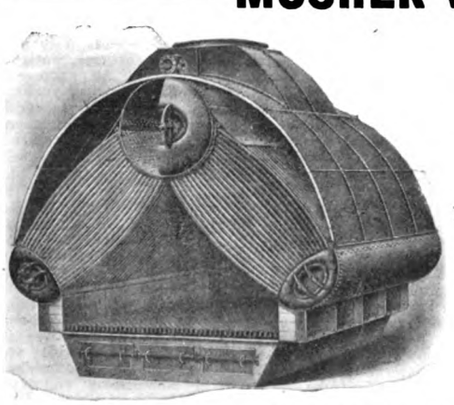

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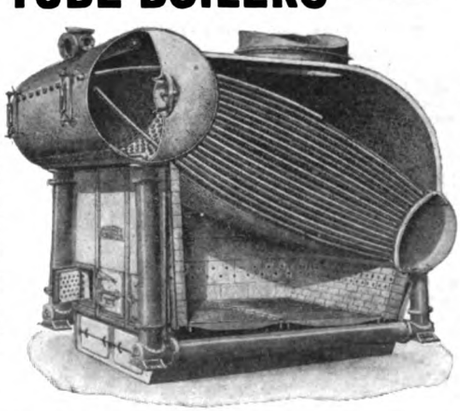

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McMYLER DERRICK FOR SALE, 3 TONS CAPACITY, 14 FT. gage. Located at Cleveland. Address E. M. Graves, 17 Commercial Bank Bldg., Cleveland, O.

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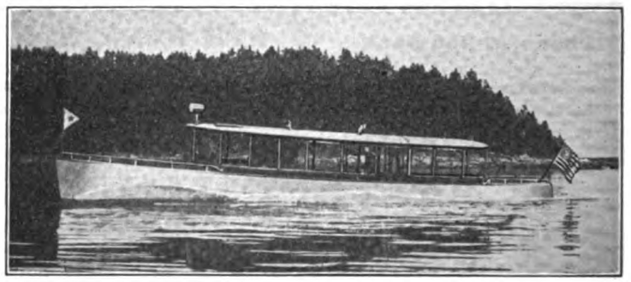
FOR SALE. WRECK OF STEEL STEAMSHIP VEGA, ASHORE on South Fox Island, Lake Michigan. Address O. G. Donaldson, 50 South Division St., Buffalo, N. Y.

WANTED COMPETENT CENTRIFUGAL PUMP MAN TO take charge of sand and gravel outfit. None but experienced need apply. Standard Contracting Co., 35 Wade Bldg., Cleveland, Ohio.

LAUNCHES FOR SALE.



FAST SPEEDWAY GASOLINE LAUNCH FOR SALE, length 45 ft.. beam 6 ft. 6 in.; draft 2 ft. 8 in., built 1907. Used about 4 months all told. Hull built with oak frames and keel; white cedar planking. Copper fastened and riveted. Mahogany planksheer, decks and coaming joint work of mahogany, has cabin forward with drop windows; toilet room with marine W. C. and folding wash basin, motor room amidship, cockpit aft for chairs, glass bulkhead and door separating motor compartment from cockpit, equipped with one six-cylinder, four-cycle Speedway gasoline engine 6½ x 8 in., speed guaranteed 22 miles per hour. This launch will be delivered in commission alongside of our dock ready for service for the low price of four thousand five hundred ($4,500.00) dollars. Boat has made trip from Morris Heights to Maine, where it was in service. Ideal launch for fast ferry use. ONLY offered for sale as owner is building larger "Speedway" yacht. Gas Engine & Power Co., and Charles L. Seabury & Company, Cons., Morris Heights, New York City.

HUNTING CABIN LAUNCH FOR SALE, 32 ft. x 8½ ft. x 26 in., Log Keel, stem in one piece, natural crook, natural crook timbers 1 in. x 1½ in. spaced 10 in. between centres, entire frame white oak, ⅞ in. cedar planking, cypress deck in narrow strips, power whistle, 21 life preservers, Spirit compass, Curtiss yacht closet. Has Ferro two-cyl. 15 horse motor and Joes reverse gear. A handsome, substantial and seaworthy craft, will go anywhere and built to last. Estimated speed 11 miles. Just completed this April. Address Mattituck Boat Works, Mattituck, N. Y.

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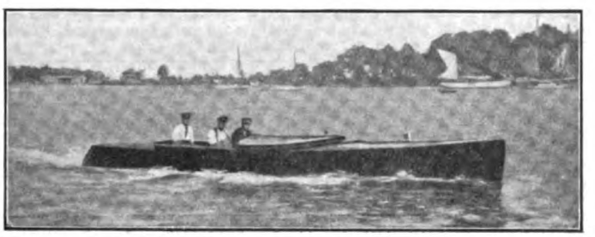
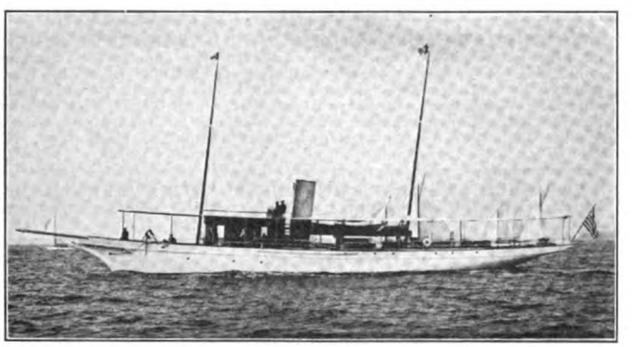
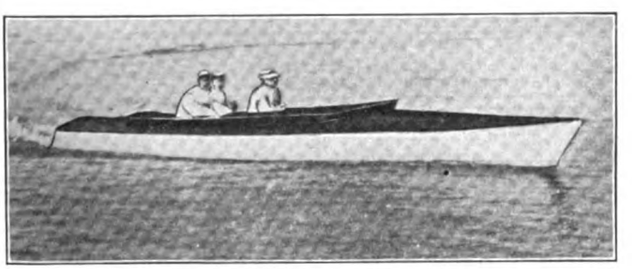


FOR SALE: "Key West;" 35 ft. x 4.5 ft. with 3-cylinder, Smalley engine; Carlyle-Johnson reverse; muffler with cut-out; McCord oiler; Witherbee storage battery; Watres Whistle; tools, lights, anchor, cushions, etc., complete. Beautifully finished inside. A strong, able boat for general service. Speed over 21 miles per hour. Price $1,500. Address F. R. Still, 1400 Russell St., Detroit, Mich.



FOR SALE OR CHARTER: STAUNCHLY CONSTRUCTED steam yacht, length over all 109 ft., water line 86 ft., beam 15 ft. 4 in., draught 7 ft. 6 in.; speed 14 miles; electric lights, power tender, etc.; deck dining saloon; owner's accommodation consists of 2 staterooms with double berths; 1 stateroom with single berth; toilet room; 2 berths in main saloon, also 2 transom berths in deck house; boat is completely and finely fitted and furnished. For plan, price and further details apply to William Gardner, 1 Broadway, New York.



MODERN HIGH SPEED FAMILY RUNABOUT FOR SALE, length 25 feet, 8-10 horse Rochester Motor with reverse gear. Speed 13-14 miles. One man control, seats 7. Built 1907 and in best of condition. Complete inventory, spray hood, etc. Will sacrifice as have no time to use. Box 94, Lockport, N. Y.

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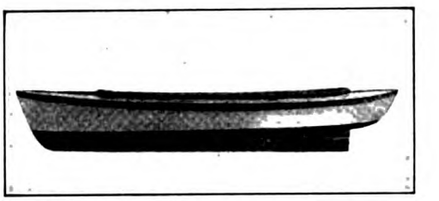
LAUNCH "DELIGHT" FOR SALE, 36 ft. o. a., 8 beam, 32 in. d., 20 H. P. Buffalo engine. Double cabin finished in quartered oak, galley, toilet and lavatory. Cost $3,000 complete; lowest price $1,600. See account of Toledo long distance race. Oct. POWER BOATING. Address W. C. Lambert, M. D., Wyandotte, Mich.



NEW 26 FT. x 6 FT. LAUNCH FOR SALE. Quartered oak panel finish, copper rivets, work and material A1. Address G. R. R., 217 Tremont St., No. Tonawanda, N. Y.

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MY $3,500 AUTOMOBILE BOAT "RED RAVEN" FOR SALE, beam 6 ft. 6 in., speed 20 miles per hour, 40-50 H. P. 4 cycle, 4-cylinder engine, exhaust under water, auto control, wicker chairs, carpet, upholstering and all running equipment. Mahogany and cherry finish. Will sacrifice at $1,850. Address R. W. Abbott, 1061 Jefferson Ave., E., Detroit, Mich.

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BARGAIN. BRAND NEW CRUISING MOTORBOAT, 33 X 8.6 x 3 ft., equipped with 15 H. P. 2 cylinder motor; toilet, hand basin, sink and complete deck fittings. Awning over cockpit: has two staterooms. An able, seaworthy, handsomely finished and fine looking boat at an attractive figure. Address J. Tannenbaum, Port Washington, L. I., N. Y.

GLASS CABIN LAUNCH FOR SALE, 25 X 7½; 12 H. P. Gray engine; speed 9 miles; cabin black walnut, hull white pine; small galley; toilet room; sailing lights, flags, anchor, liquid compass. Used one year. Cost $1,500: sell for $800.00 on account of owner's death. Mrs. P. O. Folk, Oberlin, O.

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SOME EXCEPTIONAL BARGAINS IN POWER BOATS. Get our list of cabin cruisers, open launches, canopy top launches, canoes, engines, etc. Slavin's Boat Agency, Foot of Balfe St., Toledo, Ohio.

LAUNCH FOR SALE, 25 x 6, 11 H. P., 2 cyl., Ferro engine. Fine sea boat, seats 16 to 20 comfortably; built very strong; used one season; in best of condition. Pioneer 300 line model. Owner desires to build larger boat. A $1,200 boat for $450, for quick sale. Address W. L. Beecher, Carrier Sta. H., Cleveland, Ohio.

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BOAT FOR SALE, NEW LAST SEASON, HAS A CANOPY top and is in first class condition; Detroit Boat Co. make. 16 ft. long, 5 ft. wide and has a three horse engine. Address J. G. Mills, care the Ohio Roller Mills, Cardington, Ohio.

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